ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVIII. No. 20. NEW YORK, SATURDAY, MAY 19, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. L. W. MARSHALL, Manager
BOSTON OFFICE: Delta Bldg., 10 Post Office Square, M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad St., London, E. C., HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.
Copyright, 1906, by Electrical Review Publishing Co.

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single copy, 10 cents. Back numbers, beyond one month, each . . .25

CONTENTS.

EDITORIAL:
Mme. Curie Appointed Professor at the Sorbonne..... 755
Standardization and Engineering..... 755
Electricity in the Home..... 756
Series Incandescent Street Lighting..... 756
Electrical Power Economical for Mining..... 757
The Electrochemistry of Chemistry..... 757
Illuminating Engineering Society..... 758
Magnetic Survey of the Pacific Ocean—Second Cruise..... 760
Report of the Massachusetts Board of Gas and Electric Light Commissioners... 760
A Résumé of Electrical Resonance, by Frank F. Fowle..... 761
An Electric Train Test..... 763
The Last Link of the All-American Pacific Cable, by Lewis G. Martin..... 764
New York Electrical Society..... 766
A Telephone Relay, by John Trowbridge..... 767
Coal Testing, by John Holliday..... 769
BOOK REVIEWS..... 772
A Simple Method of Measuring Sparking Voltages..... 773
Vanadium Steel..... 773
A Large Electrical Installation on Board Ship..... 773
ELECTRICAL PATENTS..... 774
Reviews of Current Engineering and Scientific Literature..... 776
National Electric Light Association..... 777
METHODS OF GETTING NEW BUSINESS..... 778
INDUSTRIAL SECTION:
The Cooper Hewitt Mercury Vapor Lamp for Industrial Lighting..... 779
Annual Meeting of the Philadelphia Company..... 780
Extensive Plant Being Built by the John A. Roebling's Sons Company..... 780
Improvements in the Mercury Vapor Lamp..... 780
Adjustable Electric Chandelier Fixtures..... 781
Single-Phase, Alternating-Current Motors..... 781
Report of the General Advancement Committee of the Electrical Salesmen's Association..... 782
Experiments on the Inductive Vienna-Innsbruck Telephone Line..... 782
Annual Convention of the Indiana Independent Telephone Association..... 783
Annual Meeting of the American Institute of Electrical Engineers..... 783
The National Electrical Contractors' Association..... 783
CURRENT ELECTRICAL NEWS..... 784

MME. CURIE APPOINTED PROFESSOR AT THE SORBONNE.

The announcement that Mme. Sklodowska Curie has been appointed professor of physics at the Sorbonne, Paris, to fill the place left vacant by the death of M. Curie will be gratifying to the host of admirers who have followed the important work which she and her greatly lamented husband have done. Few searchers in science have been more in the eye of the scientific world during the past five years than these two, and few, during the same period, have done more to justify this regard. The loss to science from Professor Curie's death was great, but we can feel assured that his distinguished helpmate will carry on the good work. In this way the loss has been made as small as possible, and Mme. Curie has the great consolation of taking up the research laid out for her husband, but in which she always took an important part and for which he always gave her the most credit.

STANDARDIZATION AND ENGINEERING.

A great deal of good work has been done during the last five or ten years to standardize electrical apparatus. Where other considerations do not come in, much may be said in favor of adopting a standard rating or a standard dimension, and little objection can be made. On the other hand, the practice may be carried too far, with the result that the standard device, when used in practice, is well suited for a few places and works badly in all others. Only a few years ago the manufacturer of electric motors made but eight or ten types, and a purchaser had no choice but to take what was offered him. This was standardization carried to excess, and that it was harmful rather than beneficial is being realized, for now one may select from a large number of types of motors, all made by the same company. These vary not only in the mechanical details, but they have differing electrical characteristics, so that, given any peculiar condition, a motor may, in general, be selected which suits it admirably. When this is not the case a new machine will be designed.

Where the new conditions call for but one or two motors, it would, in general, be good practice to use the most available motor, unless this could not be done satisfactorily; but the spread of the motor drive has been so rapid during the last few years that many new conditions have come up which involve the use of many motors, possibly hundreds, and for any such condition it is, of course, advisable to bring out a type especially adapted to it.

In other applications of electricity excessive standardization may also operate harmfully. In a paper read recently by Mr. F. R. McBerty before the Western Society of Engineers, the effects of this tendency on the telephone industry were very sensibly discussed. Mr. McBerty pointed out the admitted advantages of standardization, but also laid stress upon the disadvantageous features, which the installing engineer may minimize or wave aside in order to gain a temporary advantage. Standardization, of course, leads to a reduction in cost, but the saving thus effected is little and may be negligible where a large number of appliances are needed, just as was found true in the use of motors. In such a case it may be inadvisable to sacrifice a slight advantage in efficiency for a negligible advantage in cost.

The time-factor is also apt to be an important one during construction. In fact, it may be given undue importance, for a system may be hampered for years by standard appliances which did not exactly suit the conditions, but which were purchased because they could be got and the system started a month or two sooner.

Standardization may also tend to retard progress and hold back the development of a better class of apparatus. This fea-

ture, however, controls itself in a way, for each manufacturer desires to offer the best product for sale, and he therefore does not allow himself to be left behind by his competitors.

It has frequently been said that standardization hampers the engineer, for he is not free to design the best plant possible for any particular case, but must do the best he can with the apparatus available. This is, of course, true, generally speaking, looking at the subject from the technical point only; but from the viewpoint of a profit-making system the result may, on the whole, be good. It is interesting to note here the point made by Mr. McBerty, that, in the telephone art, the inventing has not been done by the engineers. They simply made known their desires and the manufacturers fulfilled them—a method of co-operation which, on the whole, is probably the best.

ELECTRICITY IN THE HOME.

The electric motor is becoming more and more a household necessity, though at the present time, comparatively speaking, it may be looked upon as a luxury; but the time is not far distant when it will have advanced to a more important position. The great feature of the electric system is that it makes available in the house a clean and easily controlled source of power in small units. Its first use was naturally to replace human exertion, such, for example, as driving a sewing machine. Next it displaced the manually driven fan, and supplied a source of comfort in the summer months that goes a long way toward relieving the dog days of their trials. But it has not by any means stopped here, for long flights of stairs have to-day lost their terrors, because the electric elevator is so easily installed; in fact, the control of these elevators can be made so perfect that no attendant is needed, as the passenger may run them safely.

But newer applications of the electric motor are now available for the household which, perhaps, are not so generally known. Electric dish-washers can be had, which relieve this necessary process of all its drudgery. The electric iron greatly lightens the labor of this part of the work. Knife-cleaners and grinders can be had which are electrically driven by a small motor. In fact, any household appliance which requires turning can be driven in the same way. Yet this does not by any means cover the comforts to be had from the use of this small servant, for many other uses are being found for it which contribute to the comfort of all. Electric hair-driers are now available for those who need them, and electric vibrators for those whose systems are benefited by such stimulation. It will probably not be long before electric sweepers can be purchased, which will not only make that labor easy, but entirely prevent stirring up of dust.

We have referred only to applications of the electric motor, and have by no means exhausted the list. In other directions as well electric power will effect great changes in the household, for nothing can equal the convenience and cleanliness of electric cooking appliances, and the electric lamp is admitted to be the best illuminant. In fact, electricity bids fair to convert the home into a palace of luxury, and assist mightily in solving the servant problem.

SERIES INCANDESCENT STREET LIGHTING.

The paper read by Mr. W. F. Wilcox at the recent meeting of the Illuminating Engineering Society describes a comparatively new system of electric street illumination which, it is said, is as inexpensive as the Welsbach system, and, besides, has other considerable advantages. The system, in principle, is the well-known series incandescent system introduced many years ago for just such purposes. It differs, however, from the latter in details and upon these its success depends.

In the old system lamps of the standard kind were employed, with perhaps a rather high energy consumption per candle-power. These were placed on brackets which at this time would be considered crude. The method of control was fairly simple, though not as satisfactory as could be desired. Each lamp was shunted by a small reactance coil, through which but a small current passed, under normal conditions, but which allowed the whole current to pass if the lamp were burned out or broken. At the central station means were provided—generally a number of additional lamps connected in series with the circuit—for controlling, in a measure, the current through the circuit. The system was pretty widely used, but was later abandoned, the arc lamp taking its place.

In the new system the control is much more delicate, for by adapting the series transformer developed for series arc lighting the current is automatically kept constant. To provide for the breaking of a lamp it is then only necessary to place a simple cutout device in the socket, which automatically short-circuits the lamp if it breaks. With this system the regulation may be excellent, and it is possible to adopt much longer circuits than were customary in the old system; and, further, since the control is so good, a high-efficiency lamp may be used with safety and economy. By means of the metallized carbon filament the consumption of energy as compared with the ordinary incandescent lamp may be reduced some thirty per cent, and the cost of operating becomes less, it is said, than that of the Welsbach system. Further, since the current is kept constant independently of changes in the lamps themselves, the candle-power does not fall off with time, as it does when they are burned under constant potential. Advantage may thus be taken of the fact that in the new lamp the change in candle-power is due principally to a variation in resistance, and not to blackening, so that the candle-power increases with age within limits.

In addition to these points there are other important ones, such as ease of control from a central point and the facility with which the lamps may be placed where desired, together with the other advantages which usually go with the electrical system. The new system, it is said, has been tried for a year or so past, and has given the excellent results which might be expected from it. For street lighting, where small units are preferable to large, it would seem to be admirably suited. We hope before long to be able to give a much fuller account and a better description of the details of this system.

ELECTRICAL POWER ECONOMICAL FOR MINING.

Attention has been called at various times to the advantages possessed by electrical appliances for work in mines, and installations have been described where this power has been used with much success. A noteworthy instance of this kind is described in the *Mining Magazine* for May. At the El Oro mining camp, 110 miles west of the city of Mexico, are three important gold and silver mines. This is the most important mining camp in the republic of Mexico, the monthly output being $900,000. Recently plans have been perfected for introducing electric power in this camp, and one of the mines, the El Oro, has already been pretty thoroughly fitted out. The other two are to be equipped as soon as may be. The equipment of this mine presents no unusual features, except perhaps the relation of the site to the source of power. The power is brought to it from the power plant of the Mexican Light and Power Company at Necaxa, sixty miles east of Mexico, and therefore 170 miles from the mine. The transmission is by three-phase currents at 40,000 volts.

Another feature, also unusual on this side of the Atlantic, though used to some extent in Europe, and recently introduced in England, is the method of hoisting. This is by the so-called Ilgner system, which was commented upon in the issue of the ELECTRICAL REVIEW for April 21. The feature of this system is the use of a heavy flywheel mounted on the shaft of a motor-generator, the motor of which has a drooping speed characteristic. In this way the flywheel absorbs power when the hoist is not in use and gives it out when hoisting begins. The system seems to have been most successful where it has been installed.

The other applications of the electric motor at these mines are for driving water pumps for circulating the cyanide solution, for running the conveyors and stamps, and other mechanical operations involved in extracting the metal from the ore. The total amount of power to be utilized at the El Oro mine is estimated at 3,000 horse-power. A number of the motors in the mill have a very respectable size, that driving the stamp mill being rated at 550 horse-power. It is of the synchronous type, and it is said that the constant speed at which it runs is a valuable feature for this character of work.

It is purposed to install machinery at the other two mines which will absorb, in the one case, 3,000 horse-power, and in the other 4,000. The whole mine will thus take about 10,000, which is a very respectable load.

Although these large loads are to be contracted for, the price charged for the power is $50 in gold per horse-power-year, which, in other more favored localities, would seem rather high. In this particular case, however, the price seems to have been satisfactory, for it is reported that a considerable saving has been effected through its introduction. During the month of February it is said that $20,000 was saved through this means. The power superseded by the new system was steam, generated by means of wood-fired boilers. Apparently the latter method, although the best available until the electrical supply could be obtained, was troublesome, expensive and probably uncertain. A large number of laborers was required to get in the fuel. The showing already made is eminently satisfactory, considered from a financial viewpoint, but it is undoubtedly true that other gains have been made which do not yet show on the balance sheet. In the first place, it is said that the output of the mines will shortly be increased at least ten per cent, due largely, no doubt, to the better facilities furnished by the electrical equipment. This is the result which has followed almost universally when older methods of driving have been superseded by the electric motor. There are also the additional advantages accruing from the use of the easily controlled and clean motor in place of belts and ropes or small, inefficient, unreliable engines. There are a number of important modern electrical installations in Mexico, notably in the neighborhood of the capital city, and it is highly gratifying to learn that the great industries of the country are availing themselves of the modern power.

THE ELECTROCHEMISTRY OF CHEMISTRY.

The presidential address of Dr. Wilder D. Bancroft at the ninth general meeting of the American Electrochemical Society was particularly interesting, for it pointed out the great aid to the chemist of electrochemical methods and called attention to certain new adaptations of electrical energy in the synthesis of organic compounds which have opened a wide and promising field for investigation.

The analytical chemist has already applied to his purposes a number of electrochemical methods, and thus saved a great amount of trouble and valuable time; but the point dwelt upon in the address was the value of these methods in actual research work. Certain problems, particularly those of corrosion, are of great industrial importance. Fortunately, this takes place slowly, though this is an unfortunate feature so far as the research work is concerned. Dr. Bancroft's point was that in many of these reactions it can be clearly shown that the process is the same, whether it be brought about by slow chemical action or the much quicker electrolytic action. This being true, an experiment giving definite and weighable results can be conducted, electrolytically, in a few hours' run, whereas if conducted by the simple chemical method it would require weeks, possibly months. This saving is an enormous advantage, for besides increasing the amount of work which can be done by the investigator, it will induce men to go into the work who would otherwise be discouraged by the slowness with which results can be obtained.

The last phase of the address referred briefly to the synthesis of organic compounds by means of the silent electric or so-called brush discharge. Certain organic compounds have in this way been prepared from inorganic materials, and although this has been done by purely chemical methods, the new process forms an important tool for the aid of the student of organic chemistry and will doubtless lead to very valuable results. In addition to this phase, it was pointed out that there is a probability that such synthesis more nearly approaches the actual conditions under which compounds are formed in nature than do the older methods, and that therefore we are getting nearer and nearer to organic processes. It is evident that a most promising field is open here, which is sure to attract many earnest workers.

Illuminating Engineering Society.

A meeting of the Illuminating Engineering Society was held at the Edison auditorium, 44 West Twenty-seventh street, New York city, Friday evening, May 11, to hear and discuss three papers on street lighting. The first of these, presented by Messrs. W. Underwood and V. R. Lansingh, entitled "A Method of Street Lighting by Incandescent Lamps," in the absence of the authors was read by Mr. H. M. Lauritzen. This paper describes the lighting of Broadway, Los Angeles, Cal., by means of incandescent lamps. A brief reference is made to the use of these lamps for lighting the business section of certain cities, particularly Columbus, Ohio, where strings of incandescent lamps have been placed in arches across the streets. The resulting illumination is fairly good, but the method of hanging the lamps was criticised.

The method adopted at Los Angeles was first installed by property owners on Broadway, but was later turned over to the city. It consists of ornamental posts placed an average of 100 feet apart, each post being directly opposite one on the other side of the street. The lights are placed upright, which, while not so efficient as if they had been placed in a pendant position, renders the liability to breakage less and protects the passers-by from falling pieces of glass. The post is a cast-iron column having three cross-arms. In the centre is placed a ball of ground glass, rough on the inside and eighteen inches in diameter, which contains six thirty-two-candle-power lamps in two tiers. Surrounding this are six eight-inch balls on the arms, each containing one thirty-two-candle-power lamp. All lamps burn from dark until midnight, after which hour the lamps on two of the four posts at corners of the street are turned off. The voltage employed is 110. The posts cost $110 each, and there are in all 134, covering a distance of ten blocks. Some trouble at first, due to heating of the rubber insulation on the wire, has been overcome by substituting an asbestos covering.

The system of illumination, which was installed at the cost of the property owners, was turned over to the city as a gift, with the understanding that it pay for the current and that the lighting company furnish lamp renewals and globes. The satisfactory lighting which resulted has led to the extension of this plan, and a state law has been passed authorizing the city council to assess property on any street owners in order to install the system, provided two-thirds are in favor of the undertaking. Two or three other streets have already adopted the new system, with a slight change in the type of post. That on Spring street has but four arms, with twelve-inch rough glass balls containing three sixteen-candle-power lamps in each. The centre ball is sixteen inches in diameter and contains six thirty-two-candle-power lamps.

Photographs of the streets at night show apparently a satisfactory illumination. It is said that a newspaper can be read easily at any point of the street. The objections to the system are loss of light which is thrown upward, and the cost. Efforts are now being made to overcome the first difficulty.

A number of other California towns, notably Pasadena, have adopted the new system. At the latter place the posts have four arms and the balls are placed in a pendant position, with a large upright globe in the centre. These, it is said, give a better illumination, though they are not as ornamental as the others.

At Los Angeles the consumption of current is practically twelve amperes at 100 volts per post, which is the equivalent of one six-ampere arc lamp every twenty-five feet.

Mr. F. V. Westermaier read a short paper entitled "Lighting of Streets by the Incandescent Mantle Burner System." There are to-day no less than 150,000 incandescent mantle lamps, using either gas or gasoline, on the streets of our cities. This use has all developed within the past ten or twelve years. The essential part of the appliance has been evolved after a long series of tests. The old mantle produced for interior lighting was not strong enough for outdoor use, so that a special mantle has been devised. These are strong in structure, and, owing to special treatment and preparation, retain their luminous intensity longer than the average commercial mantle. These mantles are mounted by a double-wire support, and are capable of producing from twenty to twenty-four candles for each cubic foot of gas per hour, having a thermal value of 600 British thermal units. The latest development for street lighting has been an efficient gas controller, which supplies a uniform amount of gas with a variation in pressure of from one and one-half to four inches of water. Certain of these controllers have been in use for months, and after being taken to the laboratory have been found to be in excellent condition. Each lamp thus becomes an individual plant, and can be adjusted to suit the conditions under which it operates. It is important in this work not to give the lighters any more lamps than they can take care of, for cleanliness and careful adjustment are essential. As yet no satisfactory method has been devised for controlling gas lamps from a distance. The best possible service is obtained only when each lamp receives daily attention. Self-intensifying lamps for street lighting purposes have not proved successful in this country, because the mechanical appliances are not sufficiently reliable. This mantle burner system of lighting can be extended to streets where the gas mains are not carried by using gravity-feed gasoline lamps.

Mr. W. F. Wilcox, Harrison, N. J., read a paper entitled "High-Efficiency Incandescent Lamps for Street Lighting." This described a new system of lighting which has been under trial for the past year or so, with reported success. In principle the system resembles the old series incandescent system of fifteen years ago, but the methods of controlling the current and cutting out burned-out lamps are different. For controlling the current the constant-current transformer developed for series arc lighting is used, and as this is a sensitive device, a steady current is maintained. An automatic cut-out in the socket short-circuits a lamp if the filament breaks. The lamps employed are of the new metallized filament type, which is considerably more efficient than the old treated filament lamp, and has other important advantages. The advantages of the series incandescent system for street lighting are the use of low candle-power units, giving an efficient distribution, and the ability to use high line voltage for securing an inexpensive distribution system. Until the constant-current transformer had been adapted to this work the system was not satisfactory, but the excellent regulation given by this device not only affords a reliable system, but enables the metallized filament lamp to be employed. This lamp can be made with an efficiency as high as 2.5 watts per candle-power, with a life equal to that of the 3.5-watt per candle-power treated lamp. This is a gain of thirty per cent. In the older type of lamp fifty-five per cent of the loss in candle-power was due to blackening of the bulb, the rest being due to an increase in the resistance of the filament. With the metallized filament but twenty-five per cent is due to the blackening of the bulb, the rest being due to the resistance changes. On a series lighting system, however, the current is

maintained constant, so that the candle-power rises with time after a slight drop. Curves were shown illustrating this effect. On account of it it is permissible to allow the lamps a longer life, say, until the candle-power, measured at the initial voltage, falls to seventy or seventy-five per cent of its first value.

When the new system is to be adopted one must decide what efficiency of lamp is the most suitable. This can easily be computed when the lives and the cost of power are known. An instance was given as an example, and it was figured out that the best results would be obtained by using a metallized filament lamp with an efficiency of 2.7 watts per candle, which would cost forty cents, the cost of power being assumed as two cents per lamp-hour. The time of burning was 4,000 hours a year. The standard intensity is twenty-five candles. Such an installation was compared with a corresponding one using the old type of lamp. It was shown that there was a saving of $8.03 per lamp per year in favor of the new lamp. There are now forty varieties of series lamp to select from, which is rather too many. It is advisable to use circuits containing not less than 100 lamps, with voltages of from 1,000 to 5,500. The best results are obtained with low candle-power lamps of from one and one-half to three amperes, preferably one and three-quarters amperes; though if arc lamps must be used, six or six and one-half ampere lamps can be had. With the larger current lamps there is some difficulty in exhausting the globe.

As compared with the Welsbach system the advantages of the incandescent series system are: ease of control; it is less affected by the weather; the lamps are more easily rated and tested; the light is yellow; the system is easily installed on rural streets and throws the light down; the lamps may be placed over the street, and thus avoid shadows cast by the shade trees. With power at five and one-half cents per kilowatt-hour, the system is on a par with the Welsbach system.

Opening the discussion, Mr. J. T. Cowling pointed out the tendency, during recent years, toward smaller units for street lighting. This is mainly on the score of economy, although there is some objection to the arc on account of the glare and the unsatisfactory lighting between widely spaced units. Changes are being made mostly to reduce the cost of illumination, and not because of unsatisfactory lighting. The arc lamp will last for street lighting, but the incandescent will be used in certain sparsely settled districts. The Los Angeles installation was criticised, as it is using about five times the energy employed on Broadway, New York.

Mr. F. V. Westermaier spoke of some recent tests made at Hartford, Ct., in which the inspector noted the distances from various lamps at which he could read a newspaper comfortably. These distances were about twice as great for the Welsbach lamps as for the incandescent lamps. The distribution from these lamps is nearly horizontal, and the maximum intensity is found about ten degrees below the horizontal. It is thought that the Welsbach street lighting system is holding its own well.

Mr. W. T. Morrison said that better metallized lamps can be had if the company is willing to accept them in lots having slightly differing current ratings. There is no objection to doing this, as the transformers can be set so as to maintain the proper current in each circuit. No trouble has been experienced with the breaking of globes, and for this reason pendant lamps are the better. It is thought that there is an excessive consumption of current for the Los Angeles installation, as on Fifth avenue, New York, where the lighting is admitted to be excellent, there is only 6.65 kilowatts per thousand feet of street, as against 26.5 for Los Angeles. In certain suburban series systems a satisfactory illumination has been obtained with only 0.85 kilowatt per 1,000 feet.

Mr. J. W. Cowles said that the Boston Edison Company had not been interested in incandescent series lighting systems until within the last two years. Now that the company has extended its system to the smaller suburban towns it has taken up the matter, and has in service about 6,000 small units of from twenty-five to thirty-two candle-power each. The company in this way is now able to hold its own against the Welsbach system. The whole subject of street lighting is in a rather unfortunate condition, since there has been no systematic compilation of data. The artistic effect of the Los Angeles system was good, and, no doubt, the lighting was excellent; but the consumption of current was much too high.

Mr. T. J. Lytle, Jr., said that the Welsbach mantles give a much higher candle-power than has been assumed; that of a number that he has tested, none ran below sixty candles. A good allowance is twenty candles per cubic foot of gas per hour. Under good conditions twenty-five candles per cubic foot per hour can be secured. He called attention to the recent improvements in the Welsbach mantles, which give a much better quality of light.

Mr. W. D'A. Ryan said that the illumination of Fifth avenue, New York, took only three watts per square foot of street. In Buffalo they ran as high as four to five. In Los Angeles they seemed to be using twenty-five, which was a big jump. The importance of the reflector was pointed out, as the amount of light which ordinarily would go up should be turned down within the angle from zero to twenty degrees below the horizontal.

Replying to a question, Mr. Westermaier said that the use of the chimney on the Welsbach mantles did increase the draught somewhat and lower the efficiency a little, but it had advantages. It was necessary to use a chimney when low-pressure gas is employed.

Mr. John Campbell, Boston, Mass., pointed out the inadvisability of depending upon physiological effects for comparing street lighting. What is necessary is not light enough to read a newspaper by, but a satisfactory street illumination.

In this connection Mr. L. B. Marks said that attention should be paid to the quality of the light. For reading, a yellow light is best, but where the natural colors of the objects seen are to be brought out shorter wave-lengths must be present.

Mr. E. L. Elliott, New York city, criticised the Los Angeles installation. While, no doubt, the effect is artistic and beautiful, it does not seem suitable for the purpose intended. Lamps of small size should never be crowded together, as is done there. Ground-glass globes are wasteful, and the clustering of the small units is illogical. A large number of small units gives an impression of a brilliant light, although the lighting itself may not be so satisfactory. It is a simple matter to design a reflector to give any distribution called for, and it is important in street lighting not only to have the street and the houses illuminated, but to see the source of light itself.

Mr. H. Le H. Smith wished to know why the new types of highly efficient incandescent lamp had not received a warmer welcome. He thought that any increase in efficiency was much appreciated by engineers. Here the large gain may be looked at either from the viewpoint of reducing the cost of operation or of increasing the output of the station.

Mr. Wilcox thought that the Los Angeles installation was a good one for the fixture men, but the placing of a number of incandescent lamps in one globe is bad, not only in principle, but because it is injurious to the lamps.

It was announced that the next meeting of the society would be held on June 8, the subject being "The Physiological Effects of Light." A paper will be presented by Dr. Louis Bell on this topic.

Magnetic Survey of the Pacific Ocean—Second Cruise.

The yacht Galilee, engaged in the magnetic survey of the Pacific ocean under the auspices of the Carnegie Institution, of Washington, left San Diego, Cal., on March 2 to enter on her second cruise. She is expected to make the following circuit of about 20,000 miles by the end of this year: San Diego, Fanning Island, Samoan Islands, Fiji Islands, Marshall Islands, Guam, Yokohama, Aleutian Islands, Sitka, and back again to San Diego.[1]

It was necessary to reorganize the scientific personnel, as the members of the staff of the first cruise belonging to the Coast and Geodetic Survey were obliged to return to their official duties at the expiration of their furloughs. The command of the vessel has accordingly now been entrusted to Mr. W. J. Peters, formerly of the astronomical and topographical corps of the United States Geological Survey. He has had considerable experience in difficult exploring work, was second in command and in charge of the scientific work of the recent Ziegler Polar expedition as the representative of the National Geographic Society.

In connection with the latter expedition, Mr. Peters obtained a valuable series of magnetic, meteorological and tidal observations at Teplitz Bay, Franz Joseph Land.

The other members of the present staff are: Mr. J. P. Ault, magnetic observer (likewise a member of the former staff); Mr. J. C. Pearson, magnetic observer (formerly instructor of physics at Bowdoin College, Maine), and Dr. E. C. Martyn, surgeon and recorder.

While the vessel was at San Diego some additional changes and improvements were made both in the ship and in the instruments employed. Sufficient funds have been allotted so as to permit carrying on the work continuously throughout the year.

The first cruise covered the following route: San Francisco, Hawaiian Islands, Fanning Island, Magnetic Equator, Hawaiian Islands, San Diego. Already most interesting results have been obtained both with reference to the accuracy of the present magnetic charts and as to the accuracy with which the magnetic elements can be determined at sea. These results will be embodied in an early publication. Although the Galilee is not entirely non-magnetic, she has smaller magnetic constants than any vessel (including the Gauss and the Discovery) thus far engaged in magnetic work.—*L. A. Bauer in Terrestrial Magnetism and Atmospheric Electricity.*

[1]The vessel arrived safely at Fanning Island on March 31, having executed successfully the magnetic work on the cruise of 3,500 miles from San Diego to Fanning Island.

Report of the Massachusetts Board of Gas and Electric Light Commissioners.

The twenty-first annual report of the Board of Gas and Electric Light Commissioners of the commonwealth of Massachusetts has just been issued. This is for the calendar year 1905. The tables given are for the annual returns for the year ending June 30, 1905.

There are now under the supervision of the board 140 companies, and the gas or electric light plants of nineteen towns and three cities. Of the companies, forty-six are engaged in the supplying of gas only, twenty-six in the supplying of both gas and electricity, and sixty-eight supply only electricity. Of the municipalities, four have plants for the supply of both gas and electricity, the others supplying electricity only.

During the year a number of new companies were chartered, the total amount of capital authorized being about $1,100,000.

During the year fifty electric meters were tested upon request of customers. This is seventeen less than the number tested the previous year. Each meter was subjected to three tests, the results showing that in seventy tests they were too fast and in eighty tests too slow.

Twenty-four applications for issues of new stock or bonds were approved during the year, the amount of securities being $2,012,000.

The report contains a very full tabular statement intended to show all action within the state in respect to the municipal ownership of gas or electric light plants prior to the year 1905.

The city council of Boston adopted a resolution authorizing the city to construct, purchase or lease and maintain, within its limits one or more plants for the manufacture and distribution of gas and electricity for furnishing light for municipal use. This order was returned to the council without being signed by the mayor. In response to the request of the mayor, the companies operating in Boston offered to sell to the city their plants at the aggregate sum of $62,942,200.

The tables giving the statistics for the municipal electric light plants show that during the year the total income was $287,189; the total expense was $352,019, leaving an apparent loss of $64,830. To this should be added interest on bonds and notes, depreciation charges and other items, leaving as the expenditures for town and city lighting $220,394.

The results of operating the gas plants were as follows: total income, $201,790; total expenses, $138,829, leaving an apparent profit of $62,961. Deducting from this interest on bonds, depreciation and other items, leaves a net gain of $7,272.

In the case of the electric light plants the showing is better than that of the previous year by about $12,000. In the case of the gas plants the net profit is about $6,000 less.

The table showing the prices charged for commercial lighting by the municipal plants indicates a great variation. At Belmont the rate by meter is eighteen cents per kilowatt-hour for incandescent lights; $7.50 per month for arc lamps. A discount of sixteen and two-thirds per cent is allowed if bills are paid promptly. At Danvers the rate is ten cents per kilowatt-hour for both incandescent and arc lamps, and power costs three, five and ten cents per kilowatt-hour, according to the amount used. At Hull the rate is twenty-five cents per kilowatt-hour for incandescent lamps; arc lamps at meter rates, plus $3 a year for rental of the lamp and fifty cents a month for the care of the lamp. A discount of forty per cent is allowed for prompt payment to yearly customers.

During the year there were seventy-four deaths from gas, and 106 accidents which did not result fatally. Of the deaths the greater number were accidental. The electric systems make a better showing, as there were but ten deaths, all accidental, and sixteen non-fatal accidents.

The report states that the average price for gas is $1.02 per thousand feet, the lowest average rate yet recorded. The number of gas stoves in use is very large. The report gives about 150,000, although this list is not complete.

The financial operations of the private plants during the year in brief are as follows: income from all sources, $8,108,265; operating expenses, $4,777,248. This leaves an apparent net profit of $3,331,017. Against the profits are charged $374,918 interest, $1,489,247 dividends and $312,084 depreciation. Deducting sundry other items from the net profits leaves an apparent deficit of $93,207. Four of the corporations included in this statement do not appear to have earned expenses; thirty others have not earned sufficient to warrant the declaration of any dividend. These companies paid in taxes $598,035.

The report contains a number of appendices, giving the profit and loss accounts of the various companies and new legislation pertaining to lighting.

A RESUME OF ELECTRICAL RESONANCE.

BY FRANK F. FOWLE, S.B.

RESONANCE.

When a sinusoidal alternating current flows in a simple series circuit the phenomena of resonance will occur if the back-electromotive force of self-induction is equal numerically to the back-electromotive force of capacity, because these two back-electromotive forces are always opposite in phase (or 180 degrees apart) with respect to each other. The sum of all the reactive forces in the circuit is then equal to those due to ohmic resistance, and when this resistance is small the current flow is correspondingly great. The potential difference at the terminals of the inductance and the capacity may each numerically exceed the impressed electromotive force. The resultant current is in phase with the impressed electromotive force and the power-factor is unity. The expenditure of energy is entirely in heating the ohmic resistances; there is, however, an oscillation of energy between the self-inductance and the capacity which is of double the frequency of the impressed electromotive force. This energy is alternately stored in the magnetic field of the self-inductance and in the dielectric of the con-

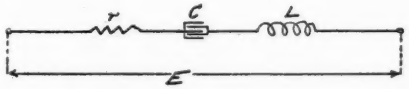


FIG. 1.—SIMPLE SERIES CIRCUIT.

denser, and its magnitude is constant. The expenditure of energy as heat is received by the circuit from the source which produces the impressed electromotive force. Such a circuit is shown diagrammatically in Fig. 1.

The total impedance is

$$Z = r - j\,(x_l - x_c)$$

where r = ohmic resistance,

$$x_l = 2\,\pi\,n\,L$$

$$x_c = \frac{1}{2\,\pi\,n\,C}$$

L = henries,

C = farads,

n = frequency in cycles per second.

The numerical magnitude of Z is $\sqrt{r^2+(x_l-x_c)^2}$ and the phase of the current with respect to the impressed electromotive force is

$$\theta = \tan^{-1}\frac{x_l - x_c}{r}$$

where θ is the angle of lag or advance as the fraction is positive or negative.

When $x_l = x_c$ the phenomena of resonance occurs and

$$L\,C = \frac{1}{(2\,\pi\,n)^2} \qquad (2)$$

The current is given by

$$I = \frac{E}{z} \qquad (3)$$

and this reduces to

$$I = \frac{E}{r} \qquad (4)$$

when the condition in (2) is fulfilled. The following table is computed from (2) expressed in the form

$$L\,C = \frac{10^6}{(2\,\pi\,n)^2} \qquad (5)$$

where L is in henries and C in microfarads. The table gives the value of L

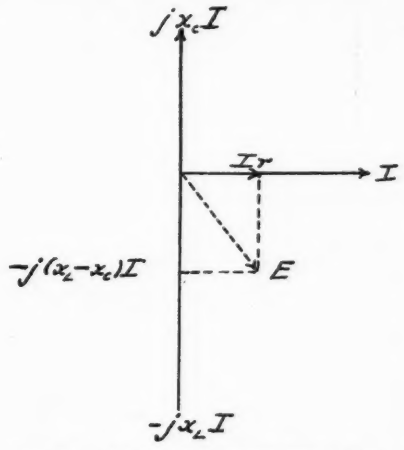


FIG. 2.—DIAGRAM OF FORCES FOR A NON-RESONANT SERIES CIRCUIT.

or C for integral values of C or L between one and twenty, at commercial values of n; the values of L and C, at any frequency, are interchangeable.

These conditions are usually secured by the use of air condensers and ironless inductances, and therefore this sort of resonance has a very limited use in the arts. Hysteresis is usually present and pulsations of the effective resistance and the effective inductance commonly occur, the former being due to molecular action, with consequent expenditure of energy, in the electric and the magnetic fields and the latter being due to local induced currents and to the variation of the per-

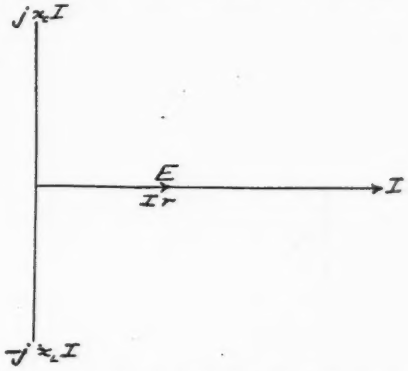


FIG. 3.—DIAGRAM OF FORCES FOR A RESONANT SERIES CIRCUIT.

meability with the magnetizing force. Resonance in circuits possessing iron inductances and artificial condensers is difficult to attain and unstable when produced. The above simple theory must be extended to a point too complicated to present here, and writings on the subject should be consulted. So-called "partial resonance" often occurs in commercial circuits; that is, the reactive electromotive forces due to inductance and to capacity are not numerically equal and there is a resultant

CAPACITY AND SELF-INDUCTION TO BALANCE EACH OTHER ON CIRCUITS, MICROFARADS OR HENRIES.*

Frequency.	1	2	3	4	5	6	7	8	9	10
15	112.58	56.29	37.53	28.15	22.52	18.76	16.08	14.07	12.51	11.258
20	63.328	31.664	21.109	15.832	12.666	10.555	9.047	7.916	7.036	6.3328
25	40.528	20.264	13.509	10.132	8.106	6.755	5.789	5.066	4.503	4.0528
33	23.259	11.629	7.419	5.815	4.652	3.877	3.323	2.907	2.584	2.3259
40	15.831	7.915	5.277	3.958	3.166	2.638	2.262	1.979	1.759	1.5831
60	7.036	3.518	2.345	1.759	1.407	1.173	1.005	0.889	0.782	0.7036
80	3.958	1.979	1.319	0.989	0.792	0.659	0.566	0.495	0.439	0.3958
100	2.533	1.266	0.844	0.633	0.507	0.422	0.362	0.316	0.281	0.2533
130	1.498	0.749	0.499	0.375	0.299	0.249	0.214	0.187	0.166	0.1498

Frequency.	11	12	13	14	15	16	17	18	19	20
15	10.235	9.38	8.66	8.04	7.505	7.035	6.622	6.255	5.925	5.629
20	5.757	5.2775	4.8714	4.5235	4.222	3.958	3.7252	3.518	3.3330	3.1664
25	3.684	3.3775	3.1175	2.8945	2.702	2.533	2.3840	2.2515	2.1330	2.0264
33	2.114	1.9385	1.7891	1.6615	1.551	1.4535	1.3682	1.292	1.2242	1.1629
40	1.439	1.3190	1.2179	1.1310	1.055	0.9895	0.9312	0.8795	0.8332	0.7915
60	0.639	0.5865	0.5412	0.5025	0.469	0.4445	0.4139	0.3910	0.3703	0.3518
80	0.359	0.3295	0.3044	0.2830	0.264	0.2475	0.2328	0.2195	0.2083	0.1979
100	0.2303	0.2110	0.1948	0.1810	0.169	0.1580	0.1490	0.1405	0.1333	0.1266
130	0.1362	0.1245	0.1152	0.1070	0.0996	0.0935	0.0882	0.0830	0.0788	0.0749

* Table compiled by Dr. A. C. Crehore.

The occurrence of resonance as described above takes place when the resistance, inductance and capacity are independent of the current flowing through them and of the potentials existing at their terminals. reactance in the circuit of small magnitude. This phenomenon is commonly troublesome rather than useful and upsets regulation. True and complete resonance can occur only with sinusoidal currents

and electromotive forces. The diagram of currents and electromotive forces in a circuit, as shown in Fig. 1, is given in Fig. 2, where resonance does not exist.

The condition of resonance is being approached and the potentials at the terminals of the inductance and of the capacity exceed numerically the impressed electromotive force or E. Fig. 3 shows the conditions when resonance exists, which may be brought about by decreasing the capacity or the inductance in Fig. 2.

The potential at the terminals of the non-inductive part of the circuit is I r and can never exceed the impressed electromotive force; the potential at the terminals of the inductance or the capacity may greatly exceed the impressed electromotive force, although not necessarily so—depending on whether the inductance is large and the capacity small, or vice versa.

It is assumed that the resistance, inductance and capacity are each concentrated, as compared with distributed. Part of the resistance may be located in the inductance and in the leads, but in any case r is the total ohmic resistance, L the total inductance and C the total capacity (in series) in the circuit. Distributed resistance, inductance and capacity occur in long lines used for transmission, and the theory of this case will be mentioned below.

The phenomenon of resonance may occur to a degree in circuits energized by non-sinusoidal currents and electromotive forces. Any complex periodic function may be resolved by Fourier's theorem into its simple sinusoidal components; if the half waves of the complex function are symmetrical, as they are when the circuit is energized by a generator, the components are of frequencies which have the proportion 1:3:5:7:9, etc. It may occur that a circuit is resonant to the fundamental frequency or to one of its harmonics. It is not uncommon in laboratory work to employ circuits tuned for resonance at the fundamental or generator frequency in order to secure currents as nearly sinusoidal as possible. Tuning a circuit for resonance at the frequency of one of the component partials in a complex wave increases the relative magnitude of that partial and produces the effect in the resultant complex wave of suppressing the other partials (or components). Tuning for resonance at the fundamental frequency tends to simplify the resultant toward a pure sinusoidal wave. But tuning for resonance at the frequency of one of the upper partials tends to increase the distortion of the resultant wave from a pure sinusoidal one, because the magnitudes of the partials decrease with their increase in frequency, and the upper partial is usually the weakest. This is not invariably true, for waves have been found with the fifth partial of greater magnitude than the third, for example; but this is not often true of the seventh and ninth. The partials above the seventh are almost always so small as to be negligible.

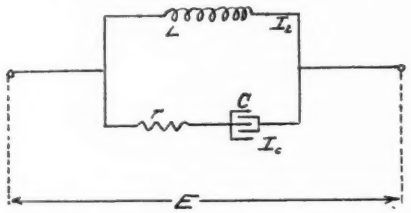


FIG. 4.—BRANCH CIRCUITS IN WHICH RESONANCE IS POSSIBLE.

There is another class of circuits in which a phenomenon akin to resonance may occur and which is sometimes called resonance. This class consists of branch or multiple circuits, constituting a network of three or more closed circuits, one of which circuits may be resonant at the frequency of the impressed electromotive force. The case to be considered will be such a circuit which does not include the generator or source of impressed electromotive force. If a circuit which includes the generator is resonant the problem involves the theory of the former case of a simple series circuit. Take the simplest case, in order to bring out the actions most clearly, of such a circuit as shown in Fig. 4.

Ohm's law extended to include alternating current parallel circuits is expressed

$$I = EY \qquad (6)$$

where Y is the sum of the admittances of the circuits in parallel. The complex expression for Y is

$$Y = g + j\,b = \frac{1}{r - j\,x} = \frac{r}{r^2 + x^2} + j\,\frac{x}{r^2 + x^2} \qquad (7)$$

If the impedance of the upper branch in Fig. 4 is $K_1 = r_1 - j\,x_1$ and of the lower branch is $K_2 = r_2 + j\,x_2$, the sum of the admittances is

$$Y = Y_1 + Y_2 = \left(\frac{r_1}{r_1^2 + x_1^2} + \frac{r_2}{r_2^2 + x_2^2}\right) + j\left(\frac{x_1}{r_1^2 + x_1^2} - \frac{x_2}{r_2^2 + x_2^2}\right) \qquad (8)$$

The current in the upper branch is

$$I_l = EY_1 \qquad (9)$$

and the lower branch

$$I_c = EY_2 \qquad (10)$$

The total current is

$$I = I_l + I_c = E\,(Y_1 + Y_2) \qquad (11)$$

When the imaginary part of equation (8) is zero, the current I and the impressed electromotive force E are in phase and the power-factor is unity. This condition is given by

$$\frac{x_1}{r_1^2 + x_1^2} = \frac{x_2}{r_2^2 + x_2^2} \qquad (12)$$

or

$$x_1 = \frac{r_2^2 + x_2^2}{2x_2} \pm \sqrt{\left(\frac{r_2^2 + x_2^2}{2x_2}\right)^2 - r_1^2} \qquad (13)$$

A special solution of (13) occurs when $r_1 = r_2$ and the result is

$$x_1\,x_2 = r_1^2 \text{ or } x_1 = x_2 \qquad (14)$$

When $r_1 = r_2$ and $x_1 = x_2$ the values of L and C may be taken from Crehore's table as for simple series circuits. A potential and current diagram is shown in Fig. 5 when resonance does not exist. It will be observed that I_1 and I_2 are neither greater than I, and that E and I are not in phase. When resonance exists the component currents may, although not necessarily, be greater than the resultant current I. The diagram of a resonant case is shown in Fig. 6.

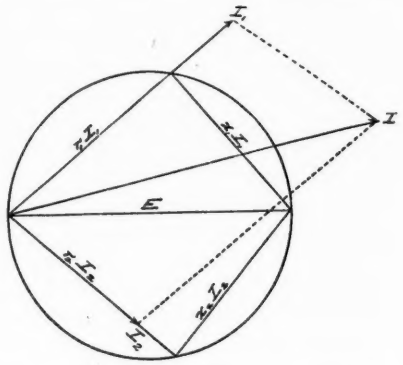


FIG. 5.—CURRENT AND POTENTIAL DIAGRAM OF BRANCH CIRCUITS NOT IN RESONANCE.

In this case I_1 and I_2 are greater than I, the resultant current. There is an oscillation of energy between the magnetic field and the electric field, as in the series circuit, of double the frequency of the impressed electromotive force. It should be noted, in comparison with resonance in the series circuit, that the addition to a given circuit of a branch circuit, thereby producing resonance, does not increase the current or the stresses in the previously existing circuit, but it may reduce the total external current delivered to the system. Resonance in parallel or multiple circuits rarely occurs to excess and when it occurs to a moderate degree is often useful. Artificial phasing devices are often useful in increasing the power-factor of a circuit and thereby improving regulation;

if the power-factor were brought to unity the circuit might be termed resonant in the sense in which parallel circuits become resonant in the manner outlined above.

These two kinds of resonance and their uses and dangers may be summed up as follows:

In constant potential circuits series resonance is dangerous owing to the excessive currents and potentials which may arise; parallel resonance is not dangerous and is frequently useful in raising the

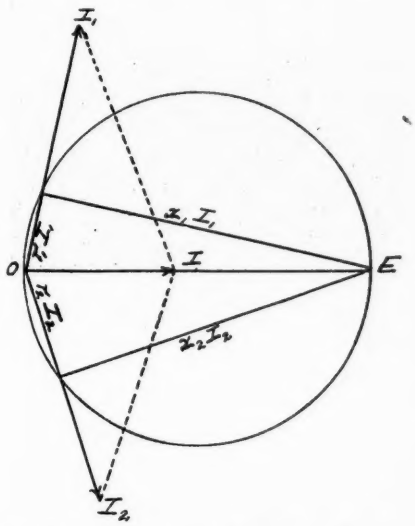


Fig. 6.—Current and Potential Diagram of Branch Circuits in Resonance.

power-factor and minimizing the inductive drop—artificial condensances for use in shunt with reactances are employed commercially.

In constant-current circuits series resonance is not dangerous and may be useful in keeping the power-factor high; parallel resonance is dangerous owing to the excessive potential which may exist at the terminals of a multiple section of a circuit and to the excessive currents which may exist within the multiple section.

(To be concluded.)

An Electric Train Test.

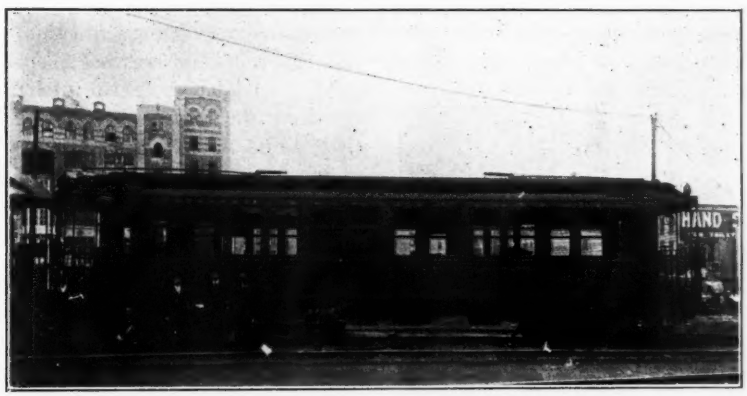
A test was made on Monday evening, May 7, by students taking the course in electric railways at the Polytechnic Institute of Brooklyn, Brooklyn, N. Y., of one of the Brooklyn Rapid Transit Company's elevated cars. This car was run over the Fifth avenue line from the yards at Thirty-sixth street over the Brooklyn bridge to Manhattan, back to Sixty-fifth street, and thence to the yards, the car leaving the yards at 9.30 P. M.

The test was made by means of a new instrument resulting from the thesis work of J. S. Hewlett and G. M. McCarty. A roll of paper ten inches wide is caused to pass, by the motion of the car, under pencils, which record the line voltage, motor current, wheel revolutions, the speed of the car and time. In addition, records were taken of the peaks of line current when accelerating, and also the peaks of the motor voltage at the same time.

This instrument was devised at the suggestion of Mr. Sydney W. Ashe, who is in charge of the instruction in electric railways at the Polytechnic Institute. Considerable trouble has been met heretofore in obtaining satisfactory results with the test sets available. The new instrument worked most successfully, giving complete and accurate data. Among other features of the equipment is a Weston tachometer, which, by means of a voltmeter, indicates directly the speed of the car.

One result of the test was the demonstration of the superiority of the Westinghouse unit switch control over the older forms of Westinghouse upright control and various methods of hand control. The acceleration given with the new control was extremely smooth.

Much of the success of the test was due to the cooperation of the various departments of the Brooklyn Rapid Transit Company. It is purposed to conduct a number of similar tests on other cars belonging to the company. These tests are being made under the direction of Mr. Ashe.



Wiring Test Car for Experimental Run.

Interior of Test Car Showing Recording Apparatus.

The Last Link of the All-American Pacific Cable.

By Lewis G. Martin.

A TRIP which includes a tour of the world is in itself sufficient to excite considerable curiosity and expectation, but, coupled with the knowledge of work to be done among, and with the assistance of, people to whom such work is entirely new and novel, it becomes positively fascinating.

A Chinese Residence En Route.

This was how matters stood when, on August 4, 1905, the writer left New York for Shanghai to lay an underground cable for the Commercial-Pacific Cable Company, to connect its Manila-Shanghai submarine cable with the cable office in the international settlement of Shanghai. Information concerning the route to be followed was meagre, but great faith (established by previous observation) in the ingenuity of the Chinese quieted all misgivings regarding difficulties likely to be encountered, and subsequent events proved that this confidence was not misplaced.

After an interesting trip through Canada down the Pacific coast to San Francisco, and a record trip across the Pacific in the Steamship "Siberia," touching at Honolulu, Midway Islands, Yokohama, Kobe and Nagasaki, Shanghai was reached on September 8. The call at Midway Islands was made in order to allow Mr. E. H. Harriman, the railroad magnate, who was on his way to Japan, to receive and send despatches, and an opportunity was given the writer to visit the cable station there.

The island on which the cables are landed is one and three-quarter miles long and at its broadest point seven-eighths of a mile across. It is quite flat and a sandy waste. A more cheerless and lonesome spot can not be imagined (and the islands were seen at their best on our visit), but all that possibly could be done for the comfort of the cable staff has been done by the Commercial-Pacific Cable Company. The offices and quarters are substantial buildings of steel and concrete construction and fitted with all modern conveniences, including acetylene gas for lighting purposes, and are most comfortably furnished. A detachment of twenty United States marines, commanded by a lieutenant, is quartered on the island, and with the cable staff, numbering about seventeen, forms the population of the islands. Good fishing, shooting and boating are to be had, and are the popular forms of recreation and sport.

The principal work to be done at Shanghai was to lay a two-inch galvanized wrought-iron pipe, inserting cast-iron junction boxes every one-eighth of a mile, and to place therein a four-conductor cable. The cable was manufactured by the Okonite Company, Limited, of New York, in accordance with specifications drawn up by the Commercial-Pacific Cable Company, the prime features of which were: weight of conductor, 116 pounds per mile; thickness of wall of insulation, three-thirty-seconds-inch, each conductor taped and leaded, and then leaded over all; insulation resistance to be not less than 1,700 megohms per statute mile at sixty degrees Fahrenheit, and conductor resistance not to exceed eight ohms per statute mile at the same temperature.

Chinese Graves—What the Cable Layers Meet.

A Cable Gang Unreeling Lead-Sheathed Cable and Rolling Reel Along Embankment.

Some novel features presented them-

selves in connection with the work, as 1.8 miles of the line had to be laid in the international settlement of Shanghai, ten miles along the embankment of the Shanghai-Woosung forts section of the Shanghai-Nanking Railroad, and 2.65 miles in the open country from Woosung forts to opposite the Chinese city of Pao-Shan, where the submarine cable is landed.

There was nothing out of the ordinary in the way of or the facilities for accomplishing the laying of the pipe line and cable through the international settlement. Means of transportation were plentiful and good, and the coolies, by the time this end of the line was reached, were well broken in.

Along the line of the railroad, and in the open country, however, things were not quite so easy. The only two ways of getting material to the railroad embankment were by means of narrow creeks which cross the railroad at more or less frequent intervals, or by the railroad itself. The creeks were all right for the lighter material, such as lengths of pipe, but of no use for heavier material, such as reels of cable, owing to shallow water and want of facilities for hoisting, and the impossibility of rolling the reels along the embankment foot-path, which was in poor condition and only three feet wide. It was necessary, then, to enlist the sympathy of the railroad authorities who, at great inconvenience to themselves (they were working night and day on their Shanghai-Nanking extension), lent us at night time, after the trains had stopped running, their steam crane and locomotive and trucks with which to place the reels.

It was a sight not soon to be forgotten to see the villagers along the line of the railroad turn out *en masse* and view with astonishment and wonder what must have been to them the mysterious doings of the foreign devils. Numerous questions were asked of the Chinese foreman and coolies, and undoubtedly many strange replies given, for the whole proceeding was as much an enigma to those questioned as to the questioners.

In the open country the reels of cable were rolled over indifferently made roads and foot-paths to their respective locations, the coolies regarding this as fine exercise and sport.

The contract for the digging of the trench, connecting up the pipe and boxes, placing in position of same and refilling of trench, was awarded to a Chinese contractor, who proved to be reliable and trustworthy. After going over in detail with him the work to be done, considerable surprise was caused by his announcing that he would join up the pipe in one-eighth of a mile sections on the opposite side of the track or street from which the trench was to be dug, and then carry it bodily across the track or street and lower it into the trench; but all fears were allayed when he said he intended to have between two hundred and three hundred coolies on the job and would put a sufficient number on the pipe so that no harm could arise. As a matter of fact, the vast majority of the pipe was laid in this way and in an exceedingly satisfactory manner.

The Chinese coolies proved themselves to be, under proper supervision, admirable workmen, quick to learn and appreciate, not afraid of hard work or long hours, and good natured and contented. There were at one time 266 coolies on the job, and the record day was 4,000 feet of completed work, not bad when one considers that the digging implements consisted of an adze-shaped hoe, a one-prong fork, ordinary field rakes and toy spades; and the vast majority of the men had either only the one or the other of these.

Several bridges had to be crossed and no difficulty was experienced in making the contractor understand the method to be adopted or in having the instructions faithfully carried out.

The cable was pulled in at the rate of one-half mile per day and in one-quarter-mile lengths, much time, however, being lost along the line of railroad in "moving up," owing to the unevenness of the foot-path and the necessity of caution on account of passing trains.

When completed the cable tested electrically perfect, the results showing an

COOLIES LIFTING WROUGHT-IRON PIPE-LINE IN ONE SECTION AND DEPOSITING IN TRENCH.

insulation resistance of 6,278.5 megohms per statute mile at sixty degrees Fahrenheit and conductor resistance of 7.158 ohms per statute mile at temperature.

From Shanghai to Woosung, a distance of about ten miles, two two-core armored cables were laid in the same trench as the pipe line for the German-Dutch Submarine Cable Company, and from the Shanghai office of the Imperial Chinese Telegraphs to the railroad, a distance of about two miles, a six-conductor lead-covered and steel-taped cable was laid, also in the same trench, for the Imperial Chinese telegraph administration. It was the writer's privilege to meet Mr. Chow Wan Pang, acting general manager of the latter, a gentleman educated at Harvard, an energetic worker and fully alive to the needs of an up-to-date telegraph service.

Chinese court attendants, in which the latter were worsted.

During the past six months cables have been laid connecting Yap, in the Caroline Islands, and Manila, in the Philippines, with Shanghai, making it, with its numerous cables running north and south along the coast of China and across to Japan, an even more important telegraphic centre in the Far East. Two cable steamers are stationed there, the Pacific and Stor Nordiske, which keep in repair all the cables in Chinese waters and vicinity. These steamers belong to the Great Northern Telegraph Company, to whose officers, particularly W. Schonau, the company's chief engineer in the Far East, the writer is indebted for valuable advice and assistance.

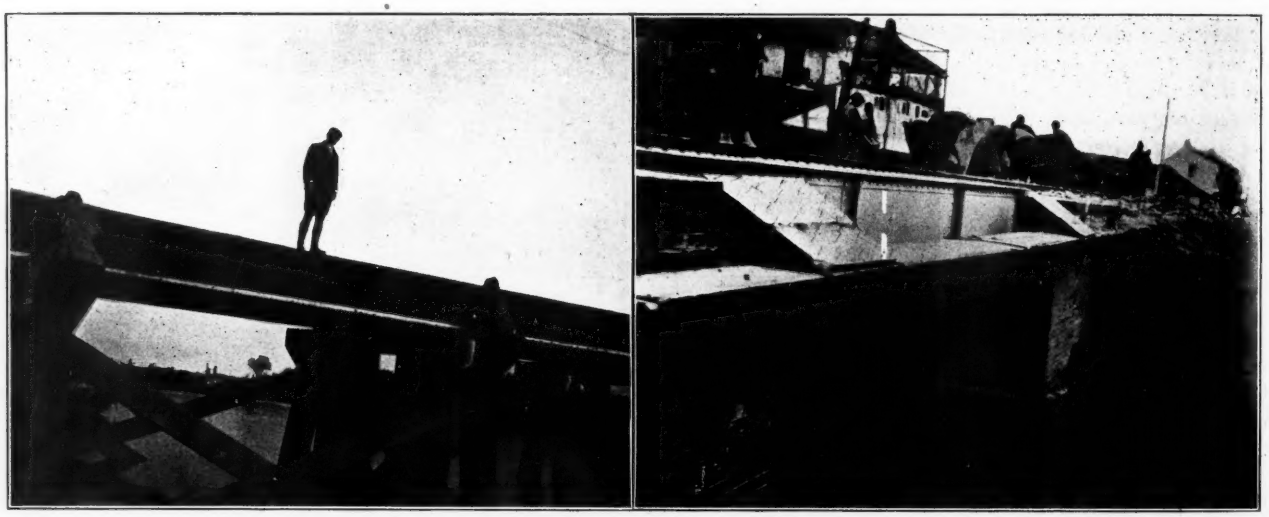
It was generally admitted during the writer's stay in Shanghai that the boycotting of American goods was practically over, but there is considerable feeling against the United States for the manner in which the Chinese are treated by the United States authorities.

There is a growing telephone company in the international settlement which, however, can not, from a prompt and reliable service point of view, be called a pronounced success. Construction work is carried on in the crudest possible manner, inviting trouble and disaster, which is all the more a pity because, with a telephone system run on modern lines, the possibilities are enormous. At present there are about 2,000 telephones in use, which, considering the population of Shanghai (including the Chinese city and French concession), roughly estimated at 1,000,000, is ridiculous. With the low rates averaging about $30 per year per instrument and the unsatisfactory management and service, the company was, according to the report for the year ending March 31, 1905, able to pay eight per cent on its share capital of 350,000 taels and place to its reserve 45,000 taels.

The electric lighting of the settlement, in the hands of the municipal council, would, if it were not for frequent failures of the service, be fairly satisfactory. Many and curious are the reasons given for such failures, and they afford chronic grumblers ample opportunity to give vent to their feelings in the newspapers.

An electric car system covering the entire settlement and suburbs is promised for the near future. All but a few minor details having been arranged, work should be commenced very shortly. A Scotch firm has secured the necessary franchise, so that in all probability contracts for material and supplies will go to Great Britain.

On December 30 the homeward journey was commenced, and short visits to Hong Kong, Singapore, Penang, Colombo, Aden, Suez, Port Said, Naples, Genoa, Paris, London and other parts of England and Ireland completed a trip full of interest from first to last.



PIPE-LINE CROSSING A BRIDGE. SPIKED TIMBERS PLACED SO AS TO PREVENT NATIVES FROM USING CONDUIT AS A FOOT-PATH.

To Mr. F. N. Dressing, chief superintendent of the administration, I am indebted for many courtesies.

Along the railroad the German-Dutch cables were laid out in true submarine style from the end of a truck hauled by a locomotive, much to the amusement of the coolies engaged and the surprise of villagers en route.

On December 18 work had to be suspended owing to anti-foreign riots in Shanghai, but was resumed again on December 21, when it was quite evident there was no further cause for alarm. The cause of the trouble was a dispute in the mixed court some days previous between the British assessor and Chinese magistrate over the disposition of a Chinese lady and some girls she was accused of having kidnapped, which led to a hand-to-hand fight between the European and

New York Electrical Society.

The next meeting of the New York Electrical Society will be held at the Edison Auditorium, 44 West Twenty-seventh street, New York city, Wednesday, May 23.

Mr. S. B. Behr will deliver an address on "A Monorail Solution of the Rapid Transit Problem," and Mr. Max Schmidt will discuss "The Moving Platform in City Transportation."

A TELEPHONE RELAY.[1]

BY JOHN TROWBRIDGE.

In histories of the invention of telegraphy much stress is placed upon the invention of the telegraphic relay; for it seemed doubtless to Joseph Henry and to Morse a complete apparatus for indefinite extension of the telegraph over land. In the progress of the telegraphic art, due to better lines and improved instruments, the telegraphic relay has lost the preeminent position it once occupied in men's minds; and the long discussions in the various treatises on the development of the art of telegraphy, in regard to the priority of the invention of the relay, have ceased to interest practical electricians.

It is natural, with the introduction of telephony, that attention should be directed to an analogous problem, that of the telephonic relay; a far more difficult problem than the telegraphic relay; and the future historian of the progress of telephony will find it difficult to analyze the work of hundreds of inventors who have sought to solve the problem.

When we consider that the telegraphic relay merely responds to one throb, so to speak, one inarticulate impulse, while a telephonic relay must reproduce the whole range of the human voice, we begin to realize the demand that the invention of such a relay must make upon both scientific knowledge of sound and of electricity and magnetism; and above all, upon mechanical skill. It does not, therefore, seem inappropriate to discuss in the *American Journal of Science,* which contains much of the work of Joseph Henry, some scientific points in connection with a telephonic relay.

The earlier inventors who attacked the problem naturally thought of the simple device of applying a microphonic contact immediately to the vibrating diaphragm of a telephone, hoping to repeat the almost infinitesimal vibrations of this diaphragm, and to give them an increase of energy by a local battery. This attempt is an application pure and simple of the principle of the telegraphic relay and therefore marks no progress in the art; for it was not new in principle and furthermore it did not work. The application of the microphonic contact loaded the diaphragm at its most sensitive point and thus prevented the vibrations which one sought to repeat; moreover, the vibrations of the diaphragm are too minute to cause a sufficient agitation of the microphonic contact.

The next step in the mind of the inventor was to endeavor to increase the vibration of the centre of the telephonic diaphragm by a lever. This arrangement was found to be inoperative, for the short arm of the lever exercised a prejudicial pressure on the vibrating diaphragm; moreover, the fundamental vibrations of the lever were superposed on the vibrations of the diaphragm, thus completely confusing speech.

It was perhaps natural to suppose that a number of microphonic contacts placed on a number of telephonic diaphragms, the telephones being arranged one after the other in tandem, might gather, so to speak, the slight vibrations of each and throw them in a united volume upon the relay line. This chorus arrangement, however, is also a failure; for the united speech is confused; much as if a number of persons singing the same note, some through the nose and others imperfectly, should undertake to transmit the note through a number of telephones. The imperfection of each microphonic contact disturbs the final result.

It must be remembered that the telephone is after all an imperfect instrument and its wonderful adaptiveness is greatly aided by the human brain, which catches at the connection of thought. This can be seen if individual words are transmitted without context. It will be found that the call girl will ask you to repeat such a collocation as "superstitious zoological veneration." Moreover the amount of energy utilized in the telephone is extremely small; most of the energy of the currents which actuate it and transmit speech is dissipated in heat. Some observers think that less than one per cent of the energy of such currents is transformed into sound-waves. We see, therefore, that the problem of the telephone relay calls for all our electrical and mechanical aids to preserve and to transmit this small percentage.

Since mechanical enlargement of the vibration of the telephonic diaphragm by levers is out of the question, the next more promising step seemed to be the bringing in, so to speak, of electromagnetic energy, and it has been proposed to cause the telephonic currents on the circuit to be relayed, to react by induction on a neighboring circuit at several points. This method gets rid of mechanical pressure on the vibrating diaphragm of the telephone, and substitutes an electrical pressure without any visible connection between the circuits. This method also is ineffective. It has, however, a certain analogy in another and more successful attempt to utilize an invisible and intangible magnetic effect without bringing a mechanical pressure on the telephonic diaphragm; this method consists in causing the telephonic currents to disturb a piece of iron, a balanced magnet, or a suspended coil in a strong magnetic field such as is found at the centre of an electromagnet or between the poles of a strong permanent magnet.

The principle of this method is that of the siphon recorder, the invention of Lord Kelvin, which is used on ocean cables. Since the current on the cable is very feeble, and can not work ordinary telegraphic instruments, some method must be used to magnify or to record the signals. The method adopted by Lord Kelvin was that of a delicately suspended coil so placed between the poles of a powerful magnet that when the feeble currents passed through this coil it oscillated; for the feeble currents animated the coil, making it an electromagnet, the poles of which sought the poles of the powerful stationary magnet. Thus a very feeble electrical current could be detected by the powerful magnetic influence to which it was subjected. Here we have a mechanical movement, the movement of a vibrating system, produced without the intermediation of visible connecting parts. The same principle has been adopted in many forms of instruments for detecting and measuring electrical currents, both in laboratories and in commercial electrical installations.

It has, therefore, occurred to many minds that by the use of this principle of magnifying the vibration of moving parts by the reaction between the feeble currents in such parts and the environment about these parts, one should be able to strengthen or repeat such vibrations. The mechanical difficulties, however, are very great if one endeavors to apply this principle to the problem of the telephonic relay. A delicate suspension such as is used in the siphon recorder or the D'Arsonval galvanometer is out of the question; and a rigid suspension prevents the turning movement, the seeking of the poles of the powerful magnet by the little coil which conveys the feeble currents. A certain measure of success, however, can be obtained by careful adjustments in a laboratory; but the utilization of the turning movement of a little coil in a magnetic field has not yet proved of commercial use in telephony.

We are apparently brought back to some modification of the simple principle of the disturbance of a powerful magnetic field by the effect of feeble currents circulating around coils placed in such fields. Suppose, for instance, that we have a hollow electromagnet with another electromagnet suspended above it, the iron core

[1] From the *American Journal of Science*, vol. xxi, May, 1906.

of the suspended magnet forming a part of the core of the stationary more powerful electromagnet. The system can evidently be balanced in various ways; for instance, the suspended magnetic core can be maintained in a definite position by connection with a telephone diaphragm; and when a feeble current circulates through the coil of such a suspended electromagnet its position with respect to the stationary coil is changed. Instead of the diaphragm of a telephone, it is evident that a diaphragm connected to a microphonic contact can be employed. This idea can be found in the efforts of many inventors to construct a relay. Professor Dolbear has described a telephone which works upon this principle; a non-magnetic diaphragm placed close to the pole of a permanent magnet carries a little electromagnet which is balanced under the influence of the elasticity of the diaphragm and the magnetism of the permanent magnet. When the voice causes the diaphragm to vibrate, the movements of the little electromagnet disturb the magnetic field, producing feeble currents of induction in the little moving coil which transmit speech to a similar piece of apparatus. If this similar receiving apparatus of Professor Dolbear had been employed to modify a microphonic contact, it would have been the precursor of many subsequent inventions.

Instead, therefore, of the turning or torsional effect relied upon to actuate Lord Kelvin's siphon recorder—called "Siphon" because a siphonic pen records the oscillations of the vibrating coil—we have efforts to utilize the to-and-fro thrust of a vibrating core of an electromagnet whose position in a powerful field is modified by the strength of the feeble telephonic currents which circulate around the core of such a magnet.

At first sight it would seem that the inertia of the suspended electromagnet, or that of its core or plunger if the coil of the electromagnet is fixed, would be so great that the motion of the microphonic contacts would be seriously impeded. It is true that the weight of the vibrating parts in this form of relay must be small, and there must not be any subsidiary vibrations of the moving parts which might be superposed upon the vibrations due to the telephonic currents. It is evident that such subsidiary vibrations can arise if the moving parts are long and of considerable size. With a loaded microphonic contact we can have feeble effects or roaring sounds, as if the membrane of the ear is loaded by an obstruction.

In this form of telephonic relay we, therefore, have a microphonic contact connected with what may be called an iron plunger, the position of which in a magnetic field is modified by changes in its magnetism by surrounding feeble telephonic currents. The only mechanical connection is that of this moving plunger with the microphonic contact.

The magnetic part of a relay embodying the above ideas can be suitably constructed so as to perform their part to a commercial degree of perfection; the principal imperfection of the relay arises from the microphonic part. Among such imperfections the most notable one is the roaring or "growling" of the microphone when a strong battery is used to get the greatest degree of sensitiveness from it. This noise, which arises in great part from crepitations produced by heat, can completely overpower telephonic transmission of speech. This crepitation is greatly enhanced by the direct connection of the plunger or moving electromagnetic coil with the microphonic contact; for the movements in the magnetic field and the crepitations in the microphone get into a swing together, mutually aiding each other. This mutual action is one of the greatest barriers to the perfection of a telephonic relay in which a close connection exists between the parts moving in the magnetic field and the microphonic contacts. To overcome this defect would be a great service to the art of telephony.

It is thought by some that this crepitation noise is analogous to that of the singing electric light arc; it can be started in any transmitter either by too strong a current or by a suitable reaction between the vibratory motions in the transmitter and the current in the telephone circuit of which the microphone is a part, for instance the roaring can be started by holding a telephone connected with the circuit directly in front of the transmitter.

With the view of accomplishing two results, I have constructed the following form of telephonic relay. These results to be attained are as follows: first, the prevention of the reaction of the magnetic parts on the crepitation of the microphone to obviate the excessive roaring or "growling"; secondly, to provide means for a separate adjustment of the magnetic moving parts and the transmitter. This separate adjustment is evidently highly desirable; for the part moving in the magnetic field may be in a suitable position for the greatest sensitiveness, while the microphonic contact has not a suitable contact pressure; and any disturbance of adjustment of one of these parts of the apparatus disturbs the other. In accomplishing these results, the fact came out with great clearness that the separation of the microphonic contact by means of an air chamber from the magnetically moving parts, a separation claimed by many inventors, is inoperative unless there is a better sound-conducting medium between the microphonic contact and the vibrating part in the magnetic field than the layer of air. In fact, the layer of separating air is incapable of transmitting the feeble vibrations of a telephone diaphragm sufficiently for relaying; while a suitable solid sound-transmitting support to the microphone in contact with the edges of a diaphragm actuated by the movements in the magnetic field transmits such vibrations very efficiently. This is an exemplification of the fact that a person partially deaf can hear if the vibrations are conveyed to the ear by contact with the supports of the ear.

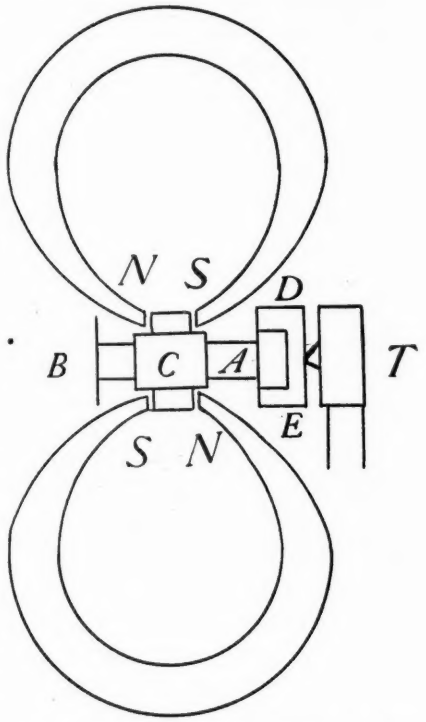


FIG. 1.—DIAGRAMMATIC REPRESENTATION OF ARRANGEMENT OF TELEPHONE RELAY.

Considering thus the principles involved in the construction of a practicable telephonic relay, I have invented the relay described below; a relay in which the barrier of undesirable "growling or roaring" is obviated; and a relay which permits of the desirable separate adjustment of magnetic parts and microphonic parts.

The relay consists of a small coil with a laminated iron core which is balanced

by two small diaphragms in a balanced magnetic field: the telephonic currents to be repeated or relayed enter the little coil and disturb the magnetic balance in the magnetic field.

In Fig. 1, NS (diagrammatic) represent the poles of the magnetic field, C the moving coil actuated by the telephonic currents to be relayed, A and B the supporting diaphragms, DE sound-communicating support of the microphonic contacts or transmitter. This can be a heavy disc: in some experiments I have used a brass disc one-half an inch thick and have relayed loud and articulate speech. The main features of this relay are these: the magnetic field acts both in the direction toward B as well as toward A.

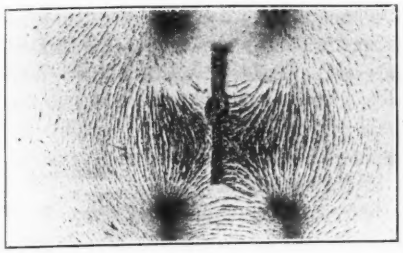


FIG. 2.—CHARACTER OF THE MAGNETIC FIELD.

Fig. 2 shows by the lines of magnetic filings the character of this magnetic field. This arrangement may be considered a modification of the principle of the siphon recorder of Lord Kelvin, in which a to-and-fro thrust or vibration takes the place of the rotating or turning effect of feeble currents actuating a small coil suspended in a strong magnetic field.

The second important principle is the freedom of the central portion of the diaphragm A from the pressure of the transmitter T. The third point is the transmission of the vibrations of this diaphragm A by means of the sound-transmitting support of the transmitter to the transmitter T. As I have already said, the air enclosed in the chamber DE plays a very small part in the transmission of the vibrations of the diaphragm A. A proof of this important fact is as follows:

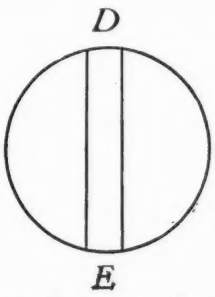


FIG. 3.—FRONT VIEW OF THE SUPPORT OF THE TRANSMITTER.

Fig. 3 represents a front view of the support DE of the transmitter, which in this case consisted merely of a metallic bar. Fig. 4 is a side view of this case. Here the air space between the transmitter and the diaphragm A is not enclosed, being open on both sides of the bar, which is connected at its edges with the diaphragm A. The transmission of speech in this case is loud, while if the connection at D and E with the diaphragm is removed and the bar upon which the transmitter rests in the same position parallel to the diaphragm A, a very feeble sound is transmitted through the intervening air.

One can, therefore, adjust the transmitter without bringing a pressure upon the most sensitive portion of the diaphragm A, its centre, and without disturbing the adjustment of the moving coil C. The relay is very sensitive; it is loud, and the articulation good. Moreover it is free from the objectionable growling or enhancing effect of the crepitation of the microphonic contacts on the vibrations of the magnetic portion of the relay. I have been much indebted to the suggestiveness and mechanical skill of the mechanician of the laboratory, Mr. George W. Thompson.

FIG. 4.—SIDE VIEW OF CASE.

The engineering problems connected with loading telephone lines are most interesting, and when completely solved may obviate the use of relays and telephonic engineering may go through a phase analogous to that of the Morse telegraph, in which as I have said the telegraphic relay is subordinate in importance to good conducting lines. Nevertheless we have not reached this point yet, and the cost of a relay is practically nothing in comparison with the enormous expense of a loaded line. The relay, described in this article, seems to me to be an important solution of the problem of the telephonic relay.

COAL TESTING.[1]

BY JOHN HOLLIDAY.

The purchaser of a quantity of coal for the purpose of steam raising does not buy the coal for its own sake, but for the sake of the heat, and eventually the power that can be obtained from it; and if it were possible, it would be highly desirable that payment should be made on the basis of the quantity of heat rather than on that of the actual weight of the mineral as determined by the weighbridge.

There are three different methods by which the calorific value of a fuel may be determined: (1) by calculation from the chemical analysis of the fuel; (2) by combustion on a small scale (a few grains) in some form of calorimeter; (3) by combustion on a large scale (a few tons) under a well-arranged steam boiler used as a test boiler.

In order to calculate the heating value of a fuel from its chemical analysis, a reliable analysis is required, and this, when not already available, is necessarily tedious and expensive to obtain. Moreover, the leading authorities are not agreed upon the values to be assigned to the various combustible elements, nor upon the allowances to be made for possible changes of state during combustion, *i. e.*, from the solid to the liquid and thence to gaseous state, nor are they agreed concerning the chemical combinations which exist previous to combustion, and their effect on the results; whether, for instance, when hydrogen and oxygen are both present they are necessarily already combined as water, or combine during combustion.

The following are the calorific values of the combustible elements generally found in all fuels: carbon, 14,544; hydrogen, 62,032, and sulphur, 4,032 British thermal units per pound.

In Dulong's method, which is commonly employed, it is assumed that all the oxygen present is combined with some of the hydrogen in the form of water, so that only the remaining hydrogen is available for combustion. Taking the analysis of the South Wales coal given above, the available

$$\text{hydrogen} = 0.045 - \frac{0.032}{8} = 0.041,$$

and the thermal units to be derived from the hydrogen are accordingly reduced from 2,791 to 2,343. Another formula used by M. Ser gives the calorific value in thermal units of any coal as $= 5{,}184$

$$\left(\frac{\text{carbon}}{3} + 8\ \text{hydrogen}\right).$$

[1] Abstract of a paper read before the Dublin Local Section of the Institution of Electrical Engineers of Great Britain on April 5, 1906.

In M. Scheurer-Kestner's paper, entitled "The Study of an English Coal," which appears in the *Bulletin de la Société de Mulhouse* (1888), vol. lviii, he compares the value of a coal as calculated by various formulæ with his own experimental result as determined by calorimeter thus:

	B. Th. U.
Calculation by the formula of Dülong...	15,214
Calculation by the formula of Scheurer-Kestner and Meunier Dolfus.....	15,455
Calculation by the formula of Cornêt....	15,613
Calculation by the formula of Ser.....	16,682
Experimental result by Scheurer-Kestner	15,955

In the above figures the calorific value is given as that of pure coal, which is in accordance with the practice of continental authorities when dealing with coal on a scientific rather than on a commercial basis, and this accounts for the high values. Nor in these figures is there any correction made for the heat which would in practice be carried away as latent heat in the steam, which is the product of the combustion of the hydrogen, but which is retained and measured in a calorimeter.

In 1900 Dr. Bünte published the results of a series of laboratory experiments on the chemical composition of almost every kind of coal used in Germany with the calculated calorific power of each according to the formula—

$$81\,C + 290\left(H = \frac{O}{8}\right) + 25\,S - 6\,W;$$

where C = percentage of carbon; H = percentage of hydrogen; O = percentage of oxygen; S = percentage of sulphur; W = percentage of moisture; and he found that the calculated values approximated very closely indeed to the values of the same fuels as determined by calorimetric experiments. The committee of the American Society of Mechanical Engineers on the standard method of conducting steam-boiler trials, dated 1889, adopted Dr. Bünte's formula.

It is generally agreed that the calorimetric determination of the calorific value of a coal is more satisfactory than any value ascertained by calculation, for the ultimate constituents of two coals may be approximately the same in their proportion and yet be very differently developed in the intermediate stage of distillation.

The determination of the exact amount of heat developed in chemical operations (generally combinations of the subjects under examination with air or pure oxygen) is a subject which has received considerable attention from a number of skilful experimenters, including Lavoisici and Laplace, Rumford, Dülong, Desprez, Favre and Silbermann, Andrews, Berthelôt, Thomson and others. Most of these devised special apparatus to test the substances they were studying, but none of them produced a simple instrument by which the calorific value of a complex material like coal could be fairly accurately determined without the assistance of highly skilled experts.

In Rumford's and Ure's instruments comparatively large quantities of combustible were used, combustion being accelerated by bellows. These instruments are of little more than historical interest. The instruments of Fischer, Favre and Silbermann, and Swackhöfer are essentially of the laboratory class, and, consequently, of less present interest than the commercial instruments of Lewis Thompson, William Thomson and the Mähler bomb calorimeter.

The Lewis Thompson instrument consists of a glass vessel which holds, when filled to a mark about one-third the distance from the top, 2,000 grammes of water. The furnace is a copper cylinder, closed at one end, which contains the charge of two grammes of finely powdered coal intimately mixed with the oxygen mixture, composed of three parts by weight of potassic chlorate and one part of potassic nitrate. A cotton fusee, prepared by dipping it in a solution of potassic nitrate and drying it, about one-half inch in length is fixed in the centre to the extent of half its length. The temperature of the water having been accurately taken, the fuse is ignited, a diving bell is fixed over the furnace on to the cover, and the whole lowered rapidly into the water, the stop-cock being closed. As the wick burns down and the coal ignites, oxygen in excess is provided by the decomposition of the potassic chlorate, and the gases escape through holes in the bottom of the diving bell and in the base, and give up their heat to the water as they rise to the surface. The combustion takes about two minutes and the temperature of the water is raised about ten degrees Fahrenheit with a fair sample of coal. But certain corrections are necessary. The heat capacity of the glass vessel, the copper cylinder and diving bell, and the thermometer must be allowed for which may be equal to that of 200 grammes of water, which is equivalent to another 1,000 thermal units, bringing the value up to 11,000 units. Then an allowance must be made for imperfect combustion, cooling losses—possibly another ten per cent, or 1,000 thermal units. The cooling losses can be determined experimentally, but the other losses can not, and they will vary with different classes of coal, so that it is better to find a constant for each instrument by burning in it a sample of coal of known heating capacity, and determining the value in thermal degrees of the thermometer. The rule of the inventor was to add ten per cent to the result of the experiment to cover all loses, but this is generally found to be insufficient.

Several points have to be observed in working with this instrument. The author of the present paper has found that with coals rich in hydrocarbons better results are obtained by increasing the proportion of oxygen mixture. Anthracite coals and coke are only burned with difficulty, and generally leave behind appreciable quantities of unburned carbon. The copper furnaces oxidize rapidly and require frequent renewals.

Dr. F. Stohmann and Herr C. von Richenberg have developed the idea of the Lewis Thompson calorimeter, and have evolved a reliable instrument, which, however, is so elaborated as to become a laboratory rather than a commercial instrument.

A better instrument for the purposes of the steam user than any of those already mentioned is that designed by Professor William Thomson, and first described by him in a paper read by him before the Society of Chemical Industry in 1886 (*Journal* of the Society of Chemical Industry, 1886, vol. v, p. 581). The diving-bell arrangement of the Lewis Thompson is retained, but instead of deriving the oxygen necessary for combustion from solid salts mixed with the fuel, it is forced into the diving bell in the gaseous state and made to impinge on the glowing fuel. In W. Thomson's original instrument one gramme of the fuel to be tested was placed in a small platinum crucible supported on a clay stand affixed to the metal base. The diving bell, of glass, is attached to the metal base by springs. Oxygen is supplied from an outside source to the copper tube, which fits loosely in the elongated stem of the diving bell, a wa' joint being made by a piece of good india rubber tubing, which permits of the copper tube being raised or lowered in the diving bell without allowing water to enter the bell. The products of combustion and excess oxygen escape through the holes in the metal base, and the bubbles of gas as they rise through the water are broken up by wire screens, and the heat they contain is thoroughly transmitted to the water. The water is contained in a glass vessel, which is protected from draughts by a metal casing.

The author has made several modifications of Professor Thomson's instrument, with a view to rendering it more self-contained and reliable in working. The outer metal case is replaced by a glass cylinder,

which allows the progress of combustion to be watched, and the whole is mounted on a stand provided with leveling screws and a support for the calorimeter thermometer, and a second thermometer to show the air temperature. A stirrup is affixed to the base, which allows the whole apparatus to be used as an agitator, and a bayonet joint is used to secure the bell to the base instead of springs. A stirrer fixed on the end of the oxygen pipe allows the fuel to be raked, so that none of it escapes contact with the stream of oxygen.

An instrument which has recently found much favor is the bomb calorimeter, originally invented by M. Berthelôt and improved by M. Mähler. In this a new principle is employed. The fuel to be tested is carried on a platinum dish and enclosed in a steel bomb, into which is introduced at a high pressure sufficient oxygen gas for combustion. The bomb is inserted in water in the calorimeter, and fired by an electric spark. The products of combustion are allowed to escape through a coiled tube closed by a tap, and it can be arranged to collect them for analysis. The apparatus gives good results in working, but requires delicate manipulation, and is necessarily expensive.

In view of the extensive and extending use of gas engines and producer gas, mention must be made of the Boys gas calorimeter, the apparatus prescribed by the Metropolitan gas referee for the calorific test of gas supplied in London. This apparatus, devised by Professor C. V. Boys, was described by him in a paper read before the Royal Society on December 7, 1905. The gas, measured by a test meter and regulated by a pendulum governor, is delivered to the pair of burners which are fixed in the base of the instrument. The burners are surrounded by a chimney which is encircled by a series of Clarkson tubes, these again by a ring of non-conducting material encircled by a second ring of Clarkson tubes, and the whole enclosed in a light metal casing which is an easy fit in the outer case; in the cover of the case are the water inlets to and the exit from the Clarkson tubes through which the cooling water circulates. The air supply is through holes in the base; the products of combustion pass through the chimney into the lower part of the water outlet casting and over the Clarkson tubes to the gas outlets. The water supply is maintained at constant pressure, and the quantity used is measured, as is also the quantity of water condensed, for which the necessary correction is made in calculating the results.

The selection and preparation of a sample of coal for test or analysis is a matter of the first importance. In dealing with a small sample, such as might, perhaps, be received by post or taken in the course of a boiler experiment, the following course is recommended: the sample is spread out on a clean metal plate, and all the larger lumps reduced to the size of peas. The whole is then well mixed, and spread out over the plate and divided by cross lines into four equal portions. Two alternate sections of these are retained and two rejected. The retained portions are then put into a sieve of about eight meshes to the linear inch, and all the lumps that will not pass through the sieve are broken down to do so. The process of mixing and halving continues till a sample of about one ounce is left. This is reduced by grinding in a mortar till it all passes through a sieve of thirty meshes to the linear inch. If the fuel is an anthracite coal or coke, it is necessary to pass it through a still finer sieve of, say, sixty meshes to the inch before burning it in the calorimeter. The sample of about ten grammes is then put into a drying bottle, weighed, and dried at a temperature not exceeding 220 degrees Fahrenheit, the process being continued till no further alteration in weight is found. The weight lost will give the moisture in the fuel as received. A portion of the sample, one to two grammes, is then weighed in a porcelain crucible and burned to destruction in a muffle furnace, and the remaining weight gives the ash or incombustible in the coal. The calorimeter samples are then taken from the drying bottle, which should be kept well stoppered to prevent oxidation of the coal, which is sometimes active with coal in a finely divided state. The importance of careful sampling can not be too much emphasized, and no analysis or calorific determination should be accepted unless evidence is forthcoming that this point has been properly observed.

Let us now consider in what respects other than its calorific power the value of coal varies. First, as regards size, it is well known that the slack or dust from any coal commands but a small price compared with that of the large coal produced with it. The variation in calorific power may be very slight, but it is generally found that at the pit's mouth large coal, which will pass over a screen of two-inch mesh, will command nearly double the price of the coal that passes through the screen, and in some cases the difference is much greater. This difference is mainly due to the fact that small coal does not burn well in ordinary furnaces with fixed bars. The small particles of coal soon close up the airways between the bars, and a fair rate of combustion can not be maintained. With the blocking of the airways the bars soon miss the cooling effect of the air passing over them, and get overheated and sometimes melted down. The difficulty is met by the use of mechanical stokers, rocking bars, etc., of which the number and variety is legion. They depend for their commercial success largely on their ability to evolve the heat contained in the small coal or slack as efficiently as the heat would be evolved in a plain hand-fired furnace with the large coal from which the slack might have been produced. Small coal is also successfully burned in fixed grates of special construction in which the bars are artificially cooled by water, as in Pinèt's furnace, or by the use of a steam jet with special bars, as in Meldrum's furnace. The late Mr. Bryan Donkin was a strong advocate of the use of small coals, and was fond of quoting cases in which the fuel bills had been reduced from fifty to ninety per cent by the use of dust and refuse fuels, but he did not always make a fair allowance for the increase in the other expenses of raising steam, which have a nasty trick of knocking the gilt off the gingerbread of such economies. The fact, however, remains that small coals are generally of a much higher calorific value as compared with large coal than the respective prices would lead one to expect, and it is to the advantage of the steam user to make use of such fuels whenever he can do so.

The character of the clinker formed, the comparative smokelessness, are among the features to be considered when comparing one coal with another, and the testing of different coals in a standard boiler under standard conditions is, perhaps, the only reliable method of arriving at a decision on such points.

There is a further property of coal which materially affects its value for the purpose of steam raising—that is, the speed at which it can be burned, or the rate at which it can be made to yield the energy stored in it. Where boiler power is inadequate it is possible that the adoption of a quicker burning fuel may prevent or postpone the expenditure of capital on additional boilers, or in a large installation may, by reducing the number of boilers to be kept in work, either increase the margin of space or reduce the size of the installation, and thus keep down capital expenditure. A due appreciation of this feature will possibly justify the steam user in being satisfied with something less than the highest economy as represented by the amount of steam produced per pound of fuel.

In conclusion, the following general rules may be enunciated as applicable to coal testing: (1) be satisfied that the sample examined absolutely represents the bulk; (2) be as sure of the results of the examination as if you had made all the determinations yourself; (3) in comparing results, leave a fair margin for variations, personal equation and other variables.

BOOK REVIEWS.

"The Theory, Calculation and Construction of Steam Turbines." Gabriel Zahikjanz. Berlin. M. Krayn. Paper. 180 pages. 6½ by 9½ inches. 23 cuts. Price, 6 marks.

This treatise on the steam turbine is reprinted from a series of articles which appeared in the journal, *Die Turbine*, 1904-1905. The treatment is very analytical, not much space being given to the details of the mechanical features.

"Electric Transmission of Water Power." Alton D. Adams. New York. McGraw Publishing Company. Cloth. 336 pages. 6½ by 9½ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $3.

This volume consists of twenty-three essays on different features of hydroelectric power development. Each chapter is complete in itself, some of them, indeed, having already appeared as studies in various journals. The author's style is clear, and the argument is easily followed. The book should be of value to all who are studying problems of the kind considered, and should be particularly useful to students, as the different features of each problem are brought out in the proper proportion.

"Shaft Governors." W. Trinks and C. Housum. New York. D. Van Nostrand Company. Cloth. 98 pages. 4 by 6 inches. 27 cuts. Supplied by the ELECTRICAL REVIEW at 50 cents.

This number of the Van Nostrand Science Series is a treatise on the theory and practice of shaft governors. The authors, having the problem presented to them of designing such governors, found the generally used analytical treatment unsatisfactory. They therefore developed a treatment for their own purposes which is given here. The present volume is not a complete study of the subject, as it covers only the statics of the problem, but it is intended to publish later a second volume. This one will probably be found of interest and assistance to those confronted with similar problems.

"Gasoline Engine Ignition." E. J. Williams. Cincinnati. Gas Engine Publishing Company. Cloth. 94 pages. 5 by 7 inches. 37 diagrams. Supplied by the ELECTRICAL REVIEW at $1.

This small treatise on gasoline engine ignition is intended to instruct the ordinary user of such appliances in the principles of electric ignition and to explain to him the peculiarities of the different types of ignition apparatus, so that he will be able to locate faults and keep the coils in operation. The treatment is simple, not too much time being spent on the theory of electricity and magnetism. Occasionally, however, a technical term is used without any explanation, and this may prove puzzling to some readers. The descriptions of the coils and the methods of using them, as well as of the other ignition appliances, contain all the information that is needed for the care of these devices.

"High-Tension Power Transmission." Vol. II. New York. McGraw Publishing Company. Cloth. 316 pages. 6½ by 9½ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $2.50.

This is the second volume of high-tension power transmission papers presented to the American Institute of Electrical Engineers. It contains besides others, those read at the International Electrical Congress, St. Louis, 1904. They are as follows: "Electrical Power Transmission," by Charles F. Scott; "The High-Tension Transformer in Long-Distance Power Transmission," by John S. Peck; "Notes on Experiments with Transformers for Very High Potentials," by Harold B. Smith; "High-Potential, Long-Distance Transmission and Control," by F. G. Baum; "American Practice in High-Tension Line Construction and Operation," by F. A. C. Perrine; "Spark Distances Corresponding to Different Voltages," by H. W. Fisher; "The Use of Aluminum as an Electrical Conductor," by H. W. Buck; "Conductors for Long Spans," by F. O. Blackwell; "High-Tension Insulators," by V. P. Converse; "Construction and Insulation of High-Tension Transmission Lines," by M. H. Gerry, Jr.; "Some Difficulties in High-Tension Transmission and Methods of Mitigating Them," by J. F. Kelly and A. C. Bunker; "Pioneer Work of the Telluride Power Company," by P. N. Nunn; "The Bay Counties Power Company's Transmission System," by L. M. Hancock; "Some Practical Experiences in the Operation of Many Power Plants in Parallel," by R. F. Hayward; "The Maximum Distance to Which Power Can Be Economically Transmitted," by R. D. Mershon; "Some Elements in the Design of High-Pressure Insulation," by H. J. Ryan; "Insulating Materials in High-Tension Cables," E. Jona. Each paper is accompanied by the discussion which followed it, and the preface of the book has been written by Dr. Louis Bell.

"The Seven Follies of Science." John Phin. New York. D. Van Nostrand Company. Cloth. 178 pages. 5½ by 8 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $1.25.

The title of this book may be misleading to some, but, as the author explains, the expression, "follies of science," has been adopted in literature, so that it is just as well to accept it. Science, of course, has no follies. The seven follies considered in the first part of the book are the famous problems of squaring the circle, the duplication of the cube, the trisection of an angle, perpetual motion, the transmutation of metals, the fixation of mercury, and the universal medicine and elixir of life. To these are added four additional follies: the perpetual or ever-burning lamps, the alkahest, palingenesy and the powder of sympathy. There are also a number of interesting paradoxes and illusions and some curious arithmetical problems. The discussions are satisfactory in general, although in some cases the problem is said to be unsolvable, though no proof is given. Some of the perpetual motion schemes are interesting, and in general the absurdity is shown, though in one case at least this is not done. The well-known scheme of causing continuous rotation by means of a rope carried over two pulleys, one vertical side being submerged in water and the other in air, is condemned because of the friction which will be set up. This is no condemnation, for, theoretically, at least, there need be no friction either at the point where the rope passes through the valve which holds back the water or in the water itself. This way of disposing of the problem is the less excusable, since the fallacy is obvious, as there is no force acting to force the rope upward. It is an interesting fact that persons endeavoring to prove to a perpetual motion crank that his machine will not work are frequently satisfied to say that it is contrary to the law of the conservation of energy, a criticism which is not satisfactory, for it is merely contradicting the man and not disproving his contentions. He says, in effect, that this law is incorrect. He does admit, however, the laws of forces, and it is generally easy, by means of them, to show the error of his argument. Another interesting point brought out in the book is that made by De Morgan in his discussion of the powder of sympathy. This powder or salve was said to be very effective in curing wounds, if it were applied not to the wound itself, but to a bandage taken from the wound or to the weapon which caused it. As De Morgan points out, the salves used in those days were fearful things, and the instructions for applying the powder of sympathy laid stress upon keeping the wound clean and cool, a method of treatment which at that time must have been most effective. Nature took care of the curing if the physician kept the conditions favorable. The book is written in a simple and popular style, which can be followed by any reader. No doubt it will prove interesting to a large number.

A Simple Method of Measuring Sparking Voltages.

A paper was read recently before the Birmingham section of the Institution of Electrical Engineers, of Great Britain, by Mr. E. A. Watson, which was the outcome of some experiments made by the author to determine the length of spark corresponding to various direct-current voltages. If a condenser be connected to a direct-current source of supply and a spark-gap be so arranged that as soon as the condenser is charged to a certain voltage it will spark across the gap, the condenser will automatically continue to charge and discharge so long as it is thus connected. If the number of sparks occurring per second are noted and also the current flowing into the condenser, and if this current be divided by the number of sparks, the result gives the quantity per spark expressed in coulombs; that is to say, the charge. Dividing this by the capacity of the condenser gives the potential difference at which that spark occurred and the air broke down.

In the arrangement used two condensers were placed in series, between them being a galvanometer or microamperemeter, and the spark-gap to be tested was connected across their outer coatings. The circuit was completed by means of a Wimshurst influence machine. In shunt to the galvanometer was a small auxiliary spark-gap of about 1/100-inch opening, and between this and the galvanometer were two small choking coils containing no iron. The object of the auxiliary gap is to prevent a reverse rush of current through the galvanometer upon discharge of the condensers, as this would give an equal deflection in the opposite direction the net reading will be zero. Since the discharge from the two condensers is very sudden and generally of an oscillatory nature, it can not pass back through the galvanometer, but passes entirely across the auxiliary spark-gap. The galvanometer thus measures only the charging current and gives a steady deflection. It should be placed symmetrically as regards both poles of the spark-gap and put at earth potential, to introduce no errors due to static charges.

The results obtained with this arrangement are plotted in curves and given in tabular form. The electrodes were balls of different diameters, and the condensers used were Leyden jars. A noticeable feature of the curves is the falling over when small balls are used. This is not in agreement with the statement that sparking distance is proportional to the pressure. The conclusion is reached that within moderate limits the sparking voltage for any gap is determined by the size of the smallest electrode, and that the other may be varied within reasonable limits without appreciably affecting the result. If unequal sized electrodes are used it is advisable that the larger one be placed on the negative pole; otherwise any advantage accruing from its use is lost. Placing it on the positive pole is worse than having no large electrode and causes brushing to commence much sooner.

The following table gives the most important results of the investigation:

TABLE OF SPARKING VOLTAGES IN KILOVOLTS.

Distance. Centimetre.	1.35 Cm. Balls (0.53 In.) Kilovolts.	1.9 Cm. Balls (¾ In.) Kilovolts.	2.54 Cm. Balls (1 In.) Kilovolts.	3.2 Cm. Balls (1.26 In.) Kilovolts.
1.0	31.1	32.4	34.05	35.0
1.5	38.0	44.2	46.25	47.5
2.0	44.1	53.0	55.6	61.0
2.5	47.5	60.45	64.0	71.0
3.0	50.5	64.5	70.7	80.0
3.5	52.9	68.0	76.6	87.9
4.0	54.5	71.5	81.4	96.4
4.5	56.2	73.6	85.7	102.9
5.0		76.9	90.6	107.1
5.5		79.2	95.0	112.0
6.0		81.4	99.2	
6.5		82.5	103.2	
7.0	Brush discharges occurred.	85.6	106.6	Disruptive discharge over condensers
7.5		87.4	Disruptive discharge over condensers	
8.0		89.6		
8.5		91.5		
9.0		94.2		

Vanadium Steel.

Consul Marshal Halstead, of Birmingham, reports that in a paper on vanadium steel making, contributed by Mr. J. Kent Smith to the Liverpool section of the Society of Chemical Industry at a recent meeting, the author stated:

"Messrs. Willans and Robinson were now producing special vanadium steel alloys at the rate of 800 tons per annum at their Queensferry works. The ferro-vanadium used for the manufacture of these special alloys was obtained from the Llanelly works of the New Vanadium Alloys Company, in South Wales, and contained up to thirty per cent of vanadium. The chrome-vanadium steels were those which showed the most remarkable properties, and these contained from ten to twenty per cent vanadium. The vanadium steel industry is altogether an English industry, eighty per cent of the production being now taken by the motor car and motor omnibus manufacturers of this country. In one case 150 axles of chrome-vanadium steel were ordered and are now running with satisfactory results, and the firm in question has given a repeat order for 400 axles of the same alloy. Chrome-vanadium steel has also been exported to France, although an import duty of £5 per ton has to be paid upon it.

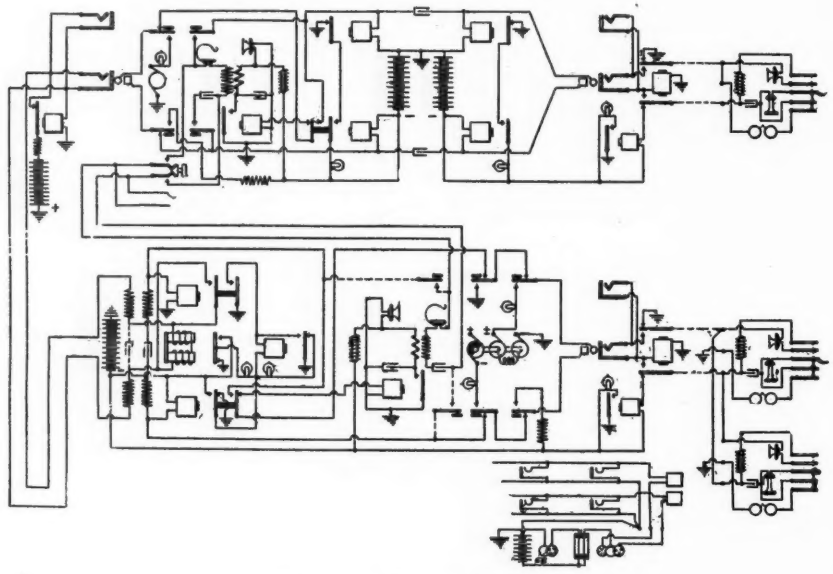
"The effect of vanadium upon ternary and quarternary steels is to increase the resistance to both static and dynamic tests, a result which is partly due, in the opinion of Mr. Kent Smith, to the action of the metal in retarding the segregation of the cerbides during cooling. The highest test yet obtained from a chrome-vanadium steel, after special heat treatment, was a maximum breaking strain test of 103 tons per square inch; this steel showing at the same time great resistance to dynamic and torsional tests. This is a combination of properties which has never been obtained before, and is the peculiar feature of the chrome-vanadium steels. The nickel-vanadium steels were of great strength, but showed much lower resistance to dynamic and torsional tests."

A Large Electrical Installation on Board Ship.

The electrical installation to be fitted on the Cunard steamer, Mauritania, building at Wallsend by Messrs. Swan, Hunter & Wigham Richardson, will be the largest and most complete ever fitted on board ship. The generating plant consists of four sets of Parsons turbo-generators, made by Messrs. C. A. Parsons & Company, and each machine will be capable of producing 4,000 amperes at 110 volts. A large portion of the auxiliary machinery will be driven by electric motors, including sixteen forced-draught fans of fifty horse-power each for the stokeholds, and about sixty horse-power for the refrigerating machinery. Two electric passenger hoists are to be fitted for conveying passengers between the six decks, and also six smaller hoists for the conveyance of stores, mails, etc., and two large luggage hoists. Electric motors are to be fitted for raising and lowering the lifeboats, heaving in the sounding line and for driving various machines in the bakery, galley and pantry. In connection with the ventilation of the ship there will be about sixty large electrically driven fans. The electric lighting of the ship will require about 5,000 lamps of sixteen candle-power. In addition to the usual electric bell system, there will be a complete telephone exchange. On the bridge deck there will be four powerful searchlights, and there will be two masthead and two side lights. In addition to this, the steam whistle will be electrically controlled, and all the watertight doors throughout will be closed automatically by electric connection from the bridge.—*Mechanical Engineer, London.*

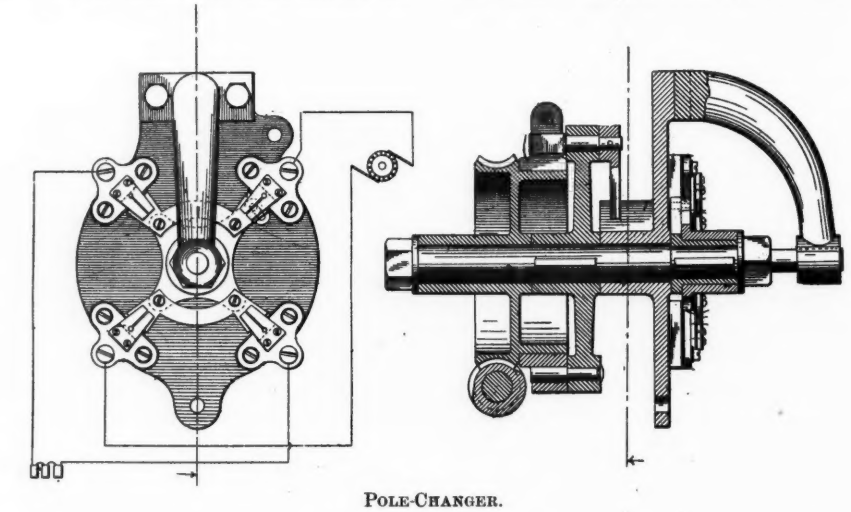
Electrical Patents.

William M. Dean, Chicago, Ill., has obtained a patent (818,527, April 24) for an improved telephone trunking system, which he has assigned to the Kellogg Switchboard and Supply Company. In the present invention one object is to provide a trunk relay which is actuated when the connection is established at the outgoing end of the trunk in a manner to prevent the operation of the disconnect signal at the incoming end and to operate the guard signal at the end in case the called subscriber's line has not been connected with by the incoming end of the trunk and to still maintain the armature of the relay in actuated condition during conversation, although its winding is deprived of operating current. A further object is to provide, in connection with a trunking system of the kind described, a polarized trunk relay and means whereby when a connection is established with the trunk circuit at the outgoing end the trunk relay armature is actuated in one direction, and when the connection is severed at that end the trunk relay is actuated in the reverse direction. The invention consists in the combination with a trunk line adapted to connect with a calling telephone line at its opening end and with a called telephone line at its incoming end, a signal at the incoming end of the trunk, a trunk relay at that end actuated by current over the trunk when connection is established at the outgoing end for preventing the operation of a signal, means actuated when the called subscriber responds for entirely depriving the relay of operating current, and means whereby the relay still remains in operated position, although deprived of operating current through any of its windings and prevents the actuation of the signal during conversation.



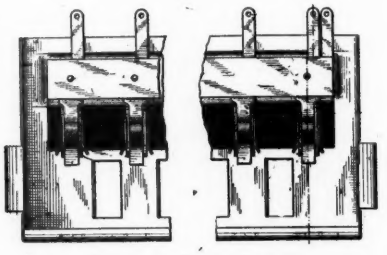
Telephone Trunking System.

Roger M. Newbold, Louisville, Ky., has obtained a patent (819,160, May 1) for an improved pole-changer, which he has assigned to the Adams & Westlake Company, a corporation of Illinois. The invention relates to automatic pole-changers for use in connection with electric circuits served by a reversible dynamo and used in connection with devices requiring a uniform direction of current. One situation in which such circuit is used is in the so-called "axle-generation train-lighting system," in connection with which there is employed a storage battery and in which the direction of rotation of the armature of the dynamo is reversed with each reversal of direction of travel of the car. The invention consists in the combination with a shaft, of a four-pointed oscillatory switch, free on the shaft, a crank arm fixed to the shaft and having a segmental slot engaging an appurtenance of the switch, a cross-arm fixed to the shaft, a worm wheel loose on the shaft and having an annular flange, a split friction band encircling the flange and fixed to the cross-arm, an oscillatory cam mounted upon the arm and located between the ends of the band and adapted to spread them, a crank arm carried by the cam and fixed stops in the path of the last-named crank arm.



Pole-Changer.

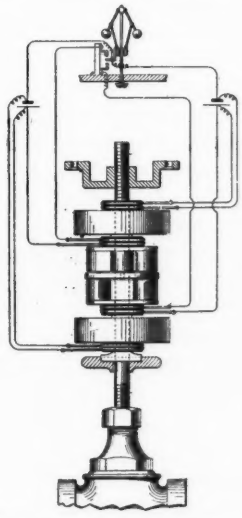
Michael Setter, Chicago, Ill., has obtained a patent (819,085, May 1) for an improved strip of lamp jacks, which he has assigned to the Automatic Electric Company, Chicago, Ill. This invention relates to what are commonly known as "lamp jacks," and more particularly to lamp jacks arranged in strips or banks, each so-called "strip" of lamp jacks involving a plurality of spring jacks or spring sockets, each adapted to receive a miniature incandescent lamp, such, for instance, as the lamps employed for signaling purposes in telephone exchanges and for other analogous purposes. Generally stated, the object of the invention is the provision of an improved, simplified and highly efficient strip of lamp jacks. A



Strip of Lamp Jacks.

special object is the provision of an improved construction and arrangement by which the body of the strip of lamp jacks may be made of sheet metal stamped or pressed into suitable form and whereby it will be impossible for the heat of the lamps to warp the front of the lamp jack strip or to distort or injure other parts of the strip of lamp jacks, as has heretofore often happened in lamp jack strips having the front and other portions made of rubber or similar material. The invention comprises a metal body having an integral upturned front plate provided with a plurality of openings, a chamber back of this plate, thimbles removably inserted in the openings, each thimble being provided at its outer end with a light transmitting member, spring jacks mounted upon the body, and miniature incandescent lamps inserted in the spring jacks, the jacks and lamps being in the chamber back of the front plate, and the bulb of each lamp projecting into the inner end portion of one of the thimbles.

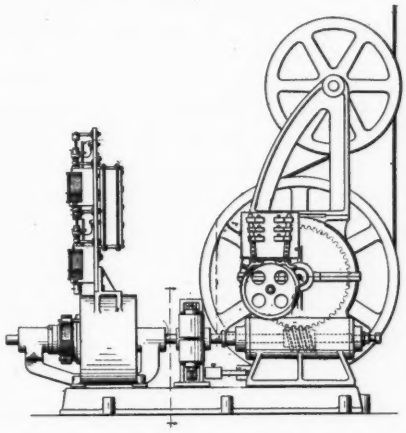
Daniel Bacon, New York, N. Y., has obtained a patent (818,513, April 24) for an improved electromagnetic governor. The object of the invention is to provide a device by means of which the action of a governor in controlling the movements of a valve or gate or other mechanism requiring automatic control is communicated by means of electromagnetism, so that the delays and dangers usually attending the



ELECTROMAGNETIC GOVERNOR.

overcoming of weight, friction and other mechanical resistance are done away with and the action of the governor is thereby rendered more certain and instantaneous. The invention consists of an electromagnetic governor, which comprises a governing device adapted to move at a speed corresponding to that of the apparatus to be governed, a circuit closer adapted to be operated by the governing device upon reaching a predetermined point of high or low speed, an electromagnetic device mounted upon the controlling stem of the apparatus to be governed and adapted to turn the stem in either direction, as may be required to increase or diminish the speed of the apparatus, and means whereby an electric current is directed into this electromagnetic device in one or the other direction by the action of the governing device in contacting with the circuit closer.

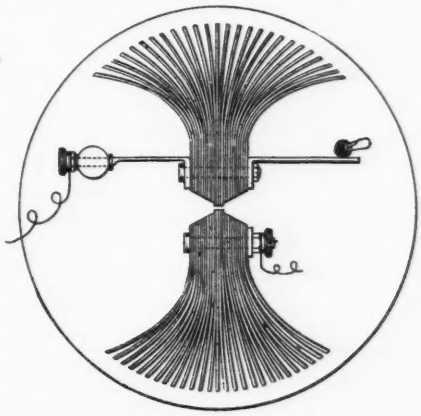
Parvin Wright, Los Angeles, Cal., has obtained a patent (819,195, May 1, 1906) for an improved electric elevator. The main object of this invention is to pro-



ELECTRIC ELEVATOR.

vide an electric elevator system of great economy and efficiency in operation. A further object of the invention is to provide for convenient and effective control of the operation of the elevator. Another object of the invention is to provide means for safeguarding the system against any possibility of injury thereto by sudden reversal of the controller or reversing switch. Another object of this invention is to provide in an elevator system of this character improved means for automatically arresting the movement of the elevator when it reaches the limit of its travel in either direction. Another object of the invention is to provide in an elevator system of this character means for arresting the movement of the elevator and generally for throwing the system out of operation upon occurrence of a slack cable by the sticking of the elevator in its descent. Another object is to provide means for the gradual and smooth starting of the elevator in operation. Another object is to provide in an elevator system of this character improved braking means for the elevator. An additional object of the invention is to provide for gradual deenergization of the motor field, thereby avoiding possibility of injury to the insulation by the self-induction discharge from the field magnet. The elevator operating system comprises the following elements: cable mechanism connected to operate the elevator, an electric motor connected to operate the cable mechanism, operating circuit connections for the motor, controlling means on the elevator cab or cage, and electromagnetically operated controlling devices adjacent to the motor, and controlling its operation and responsive to and controlled by the controller in the elevator cage. The electromagnetic controlling devices comprise a main switch operated electromagnetically to close the main circuit of the motor, a rheostatic device operated electromagnetically to gradually cut out resistance in the motor circuit, and reversing switches operated electromagnetically to reverse the circuit connections of the motor.

An improved ultra-violet lamp has been invented by Thomas B. Kinraide, Jamaica Plain, Mass. (817,976, April 17). The object of this invention is to produce a simple and inexpensive lamp for ultra-violet ray work capable of comparatively continuous use. It is found that in use the quality of the light produced by the usual ultra-violet lamps (operated by a condenser discharge) decreases as the lamps get heated, and the ultra-violet rays quickly cease on overheating of the lamps, so that it is practically impossible for effective work for any comparatively long period; yet it is desirable, if not necessary, in many instances that the production of this ray shall be not only continuous, but substantially uniform and reliable. The invention consists in the combination of an ultra-violet lamp, an electrode, consist-



ULTRA-VIOLET LAMP.

ing of a plurality of thin plates clamped tightly together at one end and separated from each other at the rear thereof, the inner plates thereof consisting of conductors effective for producing ultra-violet rays and extending forward to constitute discharge points, and the remaining plates consisting of conductors effective for radiating heat.

Reviews of Current Engineering and Scientific Literature.

Cheltenham (Md.) Magnetic Observatory Registration of the Effects from Electric Cars Over Twelve Miles Distant.

It has been found by Dr. L. A. Bauer, from a close inspection of the magnetograms obtained during the past year at the United States Coast and Geodetic Survey magnetic observatory at Cheltenham, Md., that magnetic effects are being photographically registered daily which are to be ascribed to certain electric car lines within the vicinity of the city of Washington. These records are obtained from the sensitive Eschenhagen-Edler variometers. The observatory is about fourteen miles in an air line southeast of the capital of Washington, in a district far removed from possible disturbing effects of industrial plants. This site was selected because it seemed to offer the least inducement for the penetration of electric car lines. At the present time no car lines have entered the region, though there is a possibility that within a few years a line will be constructed which will come within five miles of the observatory. At present the nearest one of the various suburban electric car lines of the city of Washington which might cause disturbing effects is twelve miles distant. The line runs southeast from Washington and has its terminal at a point twelve miles distant; but since it uses a double trolley all the way there seems to be no possibility of any disturbing effect from it. There is another line in the district, running to the southern boundary, which also uses a double trolley. There is, however, a third electric line running sixteen miles southward of Washington to Alexandria and Mount Vernon in the state of Virginia. There is always considerable travel on this road. With the exception of a stretch of track of about two miles in Washington this line employs a single overhead trolley, the return current passing through the rails. The nearest point of this road to the observatory is twelve miles, and the furthest fourteen miles, making an average distance of about thirteen miles. Between the line and the observatory lies the Potomac river, one and one-half miles wide, into which flows the Piscataway creek, which reaches within two miles of the observatory. There is a steam railroad running within a mile of the observatory. If the return currents of the electric line passed along the rails of the steam road they would have to flow along them for about fifty miles, and then pass over clear ground for a distance of about one mile. It therefore seems probable that the effect must be due to current transmitted from the electric line through water and earth a distance on the average of about thirteen miles. The records of the variometer show that the effects of the current are felt only in the interval when the cars are running, and that after 1.30 A. M. the record becomes smooth, as the line is shut down at this time. The effects also increase in accordance with the increased traffic during the day, and on Sundays they begin at a later period than on week days, also in accordance with the car schedule. An examination of the tracks of this road showed that the bonding is poor. Both the horizontal and vertical intensities vary, the former about 1-100,000 of the vertical intensity, on the average, and the latter to a less degree, possible because of less sensitive instruments. Occasional disturbances take place during that part of the night when the passenger cars stop running, and investigation showed that during this period freight cars were being run over the line. It is intended to carry out a special investigation by means of a number of instruments mounted at various points.—*Abstracted from Terrestrial Magnetism and Atmospheric Electricity (Baltimore), March.*

Electric Lighting of Lashkar City, Gwalior, Central India.

After the Coronation Durbar held at Delhi in 1903, where electricity was employed as an illuminant on a large scale for the first time in India, the maharajah of Gwalior determined to give the people of his capital the advantage of a well-lighted city. A public meeting was called, which decided that the municipality should build an electric station to light the streets and supply energy for the public in certain parts of the city. A three-wire, continuous-current system was adopted with 450 volts across the outers. The mains in general are bare copper wire carried overhead on tubular steel poles. There is, however, 2,000 yards of triple concentric cable used as a feeder in a portion of the city, and two other short lengths where the streets are too narrow and tortuous for overhead construction. The underground mains are laid on the solid system in earthenware troughing filled in with bitumen. The principal streets are lighted with thirty enclosed arc lamps placed 100 yards apart, connected five in series across the outers. The less important streets are lighted with 200 Nernst lamps placed at intervals of from fifty to 100 yards. The streets were formerly lighted by means of oil lamps. In all, about ten miles of street have been lighted electrically. To supply the Nernst lamps separate mains have been run from the feeding points, so that they will be unaffected by voltage variation due to fluctuations of the public supply load. The generating station is a stone building placed on the site of a disused gas plant. The engine room contains two high-speed engines, each direct-connected to a 120-kilowatt shunt generator. There are, in addition, two thirty-kilowatt balancers, and space has been reserved for the installation of a 300-kilowatt generator and for a storage battery. The station is served by a five-ton traveling crane. The plant was put into service in December of last year. At the present time the equivalent of 4,650 eight-candle-power lamps is connected. Current is supplied at the rate of eight cents per kilowatt-hour. The indications are that the plant will be successful financially.—*Abstracted from the Electrical Review (London), April 27.*

Speed Characteristics and the Control of Electric Motors.

In this second section of Mr. Charles F. Scott's article he takes up the application of alternating-current motors to the driving of machine tools. The general characteristics of the different types of these motors are first explained, the peculiarity of the synchronous motor being its definite speed. This motor is used principally in large sizes. It admits of no speed variation unless the speed of the generator be changed and is not self-starting. The induction motor is self-starting and normally operates at a constant speed. The speed may be changed by winding the primary so as to change the number of poles or by introducing resistance into the secondary. The latter method is useful in starting the motor, but, on account of its inefficiency, is not used for general purposes. Using two or more windings gives two or more fixed speeds and corresponds to a change of gearing. Alternating-current motors employing commutators have characteristics similar to those of direct-current motors. Those of the series type are suitable for operating hoists and cranes. A feature of the electric drive

during the past few years has been the amount of designing to meet specific conditions. Motors are made to have various ranges of speed with the particular torque curves which best fit them for operating different machines, and the same motor in electrical construction is made in different mechanical forms. The degree of this specific adaptation to particular conditions is most strikingly shown by comparing the motors which are now available with the standard motors of ten years ago. One of the large electric companies at that time did practically all of its stationary direct-current motor business with a "standard-speed" and a "slow-speed" motor. This company now offers motors for a given output made in a dozen mechanical forms, such as open, semi-enclosed, enclosed, vertical shaft, with bearings for one or more gears, etc., and these different forms are wound for a great variety of speeds and speed ranges. For the field which was covered a few years ago by a dozen motors there are now hundreds, each adapted to particular conditions; and even yet cases are continually arising which call for new designs.—*Abstracted from the Engineering Magazine (New York), May.*

Standardization of Methods and Appliances in Telephony.

The standardization of telephone methods is discussed here by Mr. F. McBerty. Some years ago it was customary to select a telephone equipment by rule of thumb. A certain quality of transmission was decided upon, and all equipments made to come up to this. Studies of the percentages of conversations since made, together with more accurate knowledge of the costs of maintaining different grades of transmission, now permit a more accurate determination of the quality of transmission which is adequate and suitably economical for any locality. It is the duty of the engineer to determine for each locality the minimum grade of transmission permissible, for to accept a single standard uniformly for all cases does not seem to be in the direction of adequate planning. The engineer fails to exercise his functions when he accepts unreservedly standards of performance which were established under unknown conditions in other places. Telephonic appliances are not standard in the sense of being adapted or associated with standards of performance. Proposals to standardize appliances are now generally agitated in order to reduce telephonic appliances to a few types for uniform application. The important considerations tending toward so-called standardizing of appliances are: reduced cost of manufacture, reduced quantity of stocks, increased promptness of supply and universal knowledge of uses and maintenances. These considerations are to be weighed against several important disadvantages. The proposal to standardize is generally made by the manufacturer whose interest it is to reduce costs by increasing the quantity of his uniform product. Where such a standardization does not reduce the price to the consumer it falls short of the possible advantages. The making of a few special appliances is costly. The making of a moderate number may approach the minimum possible cost, while a further increase of quantity will not greatly change the cost. This consideration indicates that special and unusual appliances in small numbers should be avoided, except for special uses; that a variety of standard appliances used in considerable numbers may be preserved, and that a single type of appliance should be adopted for universal use only when, upon close study, it is determined that an adequate grade of service can be attained by its use in nearly all cases. At the present time promptness of supply from stock or manufacturing is an important consideration, and this can be attained only if the variety of appliances be strictly limited. The consideration may, however, be a temporary one, and its weight can be reduced often by foreknowledge and planning. The advantages arising from familiarity with telephone appliances appear both in relation to the public users and to the operating forces of the company. The public is strikingly incompetent in the operation of mechanism. Mere unfamiliarity with the telephone greatly retarded the spread of its use. The same cause operates against it with respect to any change, even a trifling one, which affects the mode of using it. The efficiency of the company's employés is largely dependent upon their familiarity with the structures; and the existence, in a single exchange, of a variety of appliances for the same general purpose greatly increases the burden of educating these forces for their work, and faults are permitted in the structure because of unfamiliarity. The lack of uniformity in the board hampers the shifting about of operators, and will seriously impair the efficiency of the force. Lack of interchangeability in the telephone industry results in misfits, which are usually not apparent. They are left to work their insidious evils unobserved. The disadvantages of standardizing appliances are somewhat more general in their nature than the advantages. The most important of these is that standardizing prevents the natural selections which operate where a variety of forms are present to bring the fittest to the fore. The only substitute for natural selection of the best in types naturally competing is an exhaustive study and unprejudiced judgment of all structures which promise improvement or economy. Such research can be conducted only with great resources, and it then calls for foresight and persistence. A relative disadvantage of standardizing appliances appears in the inertia of ideas and of plant which results from limiting the types of appliances. In determining upon standard appliances much and often undue weight is given to the prevailing usage. Such usage will sometimes be found justified by the fact that the appliance is the survivor of many, but not rarely its wide use rests only on conservatism and inertia. In so far as it is possible, the selection of standard appliances should be based upon costs rather than prices. Prices of new and highly efficient or patented appliances are likely to have no fixed relation to costs. While it is desirable that telephone systems should be left reasonably free to improve, the engineer should be on his guard against waiting for new developments. The structure produced today will develop faults to-morrow of a sort peculiar to itself. The best example of telephone engineering practice in existence, which is also an example of the close adherence to standard methods and appliances, has been achieved almost wholly without invention on the part of the engineers who created the system. Their work has been confined to inspiring others to invent and selecting the most desirable from the product.—*Abstracted from the Journal of the Western Society of Engineers (Chicago), April.*

National Electric Light Association.

Arrangements have been made for a special train between Chicago and Atlantic City, N. J., *via* the Pennsylvania short lines, for the convention of the National Electric Light Association, to be held at Atlantic City, June 5-8. A rate of a fare and one-third on the certificate plan has been authorized for this meeting. The going ticket and certificates will be issued from June 1 to June 7, and the certificates, when validated, will be honored for return passage at one-third fare, to and including June 12.

The special train will leave Union Station, Chicago, at 2 P. M., Sunday, June 3, reaching Atlantic City early the next afternoon and in time for dinner. Tickets can be purchased reading "via Washington," allowing stop-over at Washington, Baltimore and Philadelphia.

The plan for a general exhibit of central station advertising methods, it is announced, will result in an interesting and useful display. Promises of contributions have been received from a number of companies throughout the country. The Philadelphia Electric Company has prepared and will distribute a special Atlantic City edition of its bulletin.

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

In a lengthy article in *Cassier's Magazine,* entitled "New Business for Electric Central Stations—How to Get It," Mr. Fred N. Kimball gives some very interesting suggestions with regard to methods of getting new business. The following abstracts from this article should be of value:

"Assuming that the central station is prepared to furnish current and has its territory well covered with distributing lines, its first move for an increase in business should be a campaign of advertising. In my judgment no better means of achieving publicity can be employed than the local newspapers. Such newspapers circulate directly among the only people from whom a central station clientage can be drawn. Nearly every citizen reads the local papers. . . . Well-chosen space provides enormous latent possibilities, and, having secured such space, it is well worth while to expend sufficient time and pains in preparing matter to fill it, so that one's announcement will attract attention and arouse interest. . . . An effort should be made to call attention to the various uses for which electricity is valuable in a terse, interesting manner. A small space in a prominent position, if well utilized, is preferable to a larger space filled with commonplace announcements and surrounded by ordinary advertisements or plate matter. The advertisement should not be crowded, and should deal with only one subject at a time.

"In addition to the advertisement itself, short articles should be furnished occasionally, describing new or interesting installations which the central station has made. Articles of this kind direct public attention to the various uses of electricity which are being made locally and tend to arouse interest and a spirit of emulation.

"Newspaper advertising may be supplemented by the distribution of attractive printed matter, such as bulletins or fliers, consisting preferably and principally of illustrations. The object of the newspaper advertisement is primarily to bring the central station in touch with the prospective customer and arouse his curiosity or interest in the varied uses of electricity. This is about all that can be expected from such an advertisement, and it is quite enough. The function of the bulletins and fliers is not only to supplement the work of the newspaper, but to explain more in detail the service that can be rendered and enlarge on the advantages which may be obtained therefrom.

"A record of people to whom printed matter has been sent should be kept, and this record may well be made the basis of a follow-up system, for without systematic and aggressive following-up many good prospects will be forgotten or neglected.

"Next should come the solicitor, and the best results can rarely be obtained without him. It should be this man's business to call on every one to whom printed matter has been sent and every one who may be regarded as a prospect, and endeavor to increase either the interest or curiosity which they have already manifested to the point where a contract can be closed.

"Whether the work of soliciting is entrusted to a specialist or a beginner, or even if some regular employé of the company is delegated to spend a few hours each day in soliciting, the time set apart for that purpose should never be otherwise encroached upon. If the man is not actively soliciting he should be familiarizing himself with new and novel uses for current, or perfecting his knowledge of apparatus. He must also have time to lay out his work in a systematic and methodical manner and make a study of customer's needs.

"A solicitor should never call on a customer when he is not in good bodily health and in perfect mental poise. A man with a bad cold or some other bodily ailment, or a man laboring under acute nervous strain, is rarely in the best condition to exercise a dominant influence over the person to whom he is presenting his proposition. There is everything to be gained in making the first attack properly, and a solicitor should not only be in perfect condition himself when approaching the customer, but he should be tactful enough to choose an opportune time for introducing his business.

"It is very necessary that the solicitor be acquainted with the largest number of uses to which current may be applied; otherwise he will not appreciate the possibilities which are continually being presented to extend central station service.

"A good collection of photographs showing typical installations of motors and other current-consuming devices is of great value in interesting a prospective customer as well as keeping constantly in the solicitor's mind the wide range of uses for electricity. He should also keep copies and systematic notes of his work and recommendations. These, with a scrap-book, in which may be preserved clippings describing and illustrating novel uses of electric service, may serve a very useful purpose.

"As a general rule it is inadvisable for solicitors to spend too much time in elaborating on the technical side of the propositions which they present to customers. It is better to make the principal argument along the lines of general results to be secured and the ultimate advantages to be gained.

"The next most valuable means of securing business is through a well-organized and well-equipped showroom. Such a room should be on a principal thoroughfare, on the ground floor, and, if possible, should be provided with large, low windows in which a display of electrical appliances may be made for attracting the attention of passers-by.

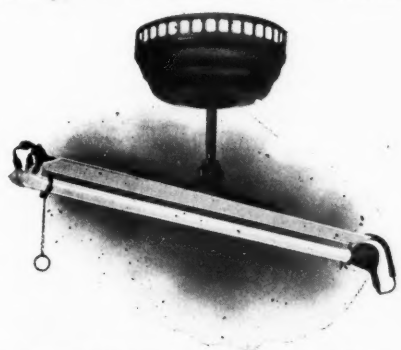
"I believe that a very considerable liberality in installing motors, heating apparatus, signs and similar devices on trial is fully justified. It not only shows confidence in the service which is recommended, but also enables a prospective customer to ascertain the advantages which have been claimed, without actually assuming responsibility himself. Experience has shown that the percentage of cases in which trial apparatus is removed, provided it has been recommended with good judgment, is well adapted to the requirements, and has been carefully installed, is very small indeed. The expense of looping in a circuit for a few days' use, particularly if the customer is to be served from overhead lines, is comparatively trivial, and the willingness on the part of the central station to make the trial always enhances the customer's confidence in ultimate results."

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

The Cooper Hewitt Mercury Vapor Lamp for Industrial Lighting.

During the past year the Cooper Hewitt mercury vapor lamp has come into wide commercial prominence, and has been adapted for many interesting and important installations in the field of industrial lighting. The records of the performance to date of mercury lamps installed in 1904 and 1905 have demonstrated that the operating life of the Cooper Hewitt tubes exceeds 5,000 hours in numerous instances. The New York Transportation Company recently renewed four tubes which had been operating over 10,000 hours each. Three of these were in fair operating condition when returned to the factory, but were somewhat blackened from long service. The tubes continue to operate perfectly until the vacuum is impaired, with no consumption of the light-giving element. Recent improvements in design and construction have increased the general utility of the tubes, and the perfection of a new type of lamp adapted to practically all alternating-current lighting circuits has greatly increased the field of its possible usefulness.

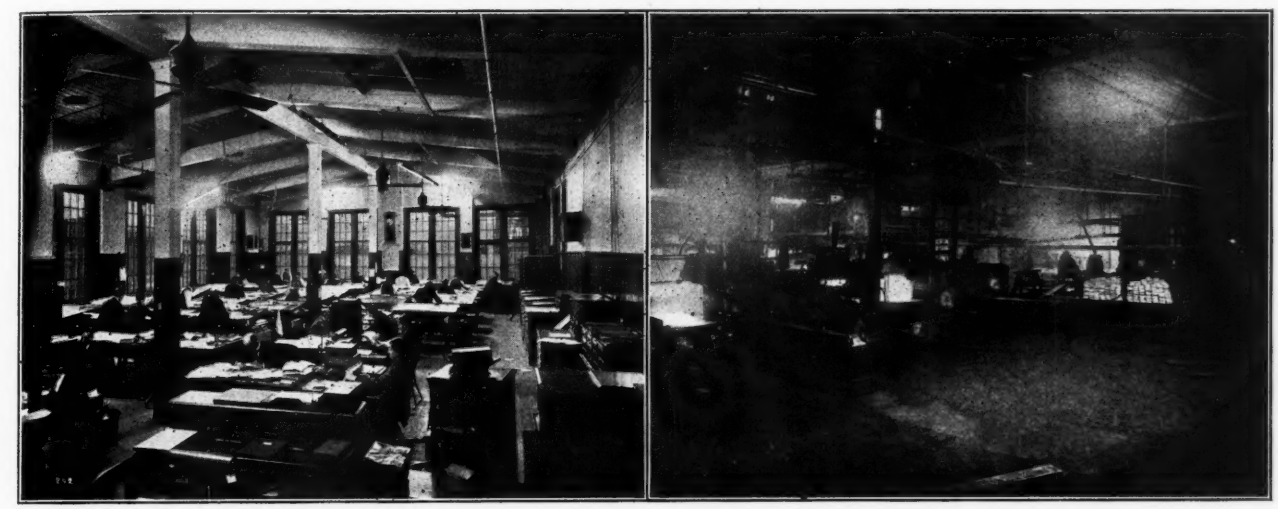


THE TYPE "C" ALTERNATING-CURRENT COOPER HEWITT LAMP.

The operating economy is well established—a candle-power of light for a current consumption of from 0.55 to 0.64 watt.

The lamp has been extensively adopted during the past two years in large machine shops and foundries, where the saving effected in current consumption has been very great; in business offices, where the peculiar working quality of the light has dictated its use, apart from the consideration of its economy; in the press and composing-rooms of many of the largest publishing houses in America, where the disadvantage of wiring around machinery is avoided by its use; in railroad repair shops, and in pier sheds and freight houses; in textile mills, where the searching character of its light is of special value.

Among prominent installations recently made may be mentioned those at the enlarged Newark, N. J., works of the Westinghouse Electric and Manufacturing Company, where 470 lamps are in use; at the new factory of the J. L. Mott Iron Works, Trenton, N. J., equipped with 113 lamps; at the new Baring Cross shops of the St. Louis, Iron Mountain & Southern Railroad at Argenta, Ark., equipped with 105 lamps; at the new Attica works of the Westinghouse Machine Company, where eighty-six lamps are used. Five of the largest river piers in New York city are lighted with the Cooper Hewitt lamp. The lamp is extensively used at the Bureau of Engraving and Printing, Washington, D. C., and the Automobile Club of America, New York city, will use ninety-six lamps in its new garage. The presses and make-up tables in the new building of the New York *Times* are lighted with forty-eight of these lamps, and the offices and pressrooms of the Butterick Publishing Company are lighted with 120 lamps. The new piano works of William Knabe & Sons, Baltimore, Md., is also lighted with Cooper Hewitt lamps.



ILLUMINATION BY COOPER HEWITT LAMPS—DRAFTING ROOM AND IRON WORKS.

THE TYPE "H" COOPER HEWITT LAMP FOR DIRECT CURRENT.

A notable example of office lighting is at the Washington post office, where thirty lamps, requiring 105 amperes in all, are used in the high vaulted mailing room, 100 by 200 feet on the ground floor. The

New York post office also has fifty-three lamps in service.

All but a few of the installations of the past year have been with the 300-candle-power type "H," and the 700-candle-power type "K" direct-current lamps. The 425-candle-power type "C" lamp for alternating-current circuits, recently put on the market, is now being delivered for various installations where the advantages of the mercury lamp have not before been possible. The type "H" lamps are generally operated in series—two in series on circuits of from ninety-eight to 122 volts, or four in series on circuits of from 196 to 244 volts. The type "K" lamps are operated singly on circuits of from ninety-eight to 122 volts, and two in series on circuits of from 196 to 244 volts. Series lamps are arranged with extra shunt resistance so that either lamp of a pair in series may be operated singly if desired. Both types of the direct-current lamp are run at three and one-half amperes, two type "H" lamps in series on a 110-volt circuit consuming 385 watts; one type "K" lamp installed singly on a circuit of the same voltage consumes the same current, and two type "K" lamps in series on a 220-volt circuit consume 770 watts. The new type "C" alternating-current lamp consumes 275 watts on either 110 or 220-volt circuits.

The complete Cooper Hewitt lamp outfit, in its latest form, consists of the glass vacuum tube, the holder and reflector, and the auxiliary. The tubes of direct-current lamps have a positive electrode of iron at one end, and a negative electrode of metallic mercury in a bulb at the other end. The tubes of the new alternating-current lamps have two positive electrodes of iron at one end, and a negative electrode of mercury at the other end, the alternating current entering the vacuum by the positive electrodes and leaving by the negative electrode. The alternating-current lamps thus really operate as a converter in application of the principle of negative electrode resistance discovered in the first invention of the mercury lamp. They are started as the direct-current lamps are started, by a temporary tilting to permit the flow of mercury from one end to the other in a small stream which momentarily bridges the vacuum, the resulting arcing of the current vaporizing some of the mercury, and the subsequent steady current flow increasing the vapor pressure and exciting it to a high degree of incandescence. Many type "H" lamps are now made with a small solenoid or magnet on the suspension bar just above the holder for accomplishing this tilting automatically when the circuit is closed. These automatic lamps are used in installations in which it would be inconvenient to reach the tilting chain with the hand or a hook.

The auxiliary, consisting of two or three coils of resistance wire, an inductance coil, and usually a ballast bulb to correct abnormal voltage variations, all connected in series with the tube, is enclosed in the new lamps under a neat twelve-inch metal canopy, and fastened securely to the ceiling above the lamp on a plate attachment having a crowfoot into which the lamp suspension bar is screwed, thus becoming a part of the lamp fixture. The special auxiliaries for series lamps have in addition an automatic cutout and shunt resistance. The new ballast bulb, an interesting feature of the auxiliary, provides economical protection against undue voltage rises, by means of a fine iron wire mounted in a small glass tube somewhat resembling a miniature incandescent globe, with an inert atmosphere to prevent oxidation of the wire. This iron wire possesses, to a peculiar degree, the property of increasing its resistance very rapidly as its temperature is increased, so that a lamp protected by such a ballast becomes operative through a considerable range of voltage without the loss in efficiency which would be unavoidable in the case of a voltage control by resistance possessing no such graded temperature correction.

Annual Meeting of the Philadelphia Company.

At the annual meeting of the Philadelphia Company, in Philadelphia, Pa., May 7, expected opposition to diversion of the earnings of the company toward repair of the damage done in San Francisco to the property of the United Railways and Investment Company failed to materialize. The latter company owns seventy per cent of the stock of the Philadelphia Company and its representatives were in control. The retiring directors were reelected with the exception that Richard Y. Cook succeeded George H. Earle, Jr., both of Philadelphia. B. S. Guinness, of Ladenburg, Thalmann & Company, of Philadelphia, fiscal agents for the United Railways and Investment Company, was added to the board.

President Reed denied that the dividends of the Philadelphia Company were to be increased in order to furnish money to repair the damage in San Francisco. He said that the company would operate its properties in Pittsburg and retain its earnings without reference to the other subsidiary company of the United Railways and Investment Company.

The report for the fiscal year ended March 31 shows gross receipts for the year ended March 31, 1906, $4,773,801, as against $4,496,373 for the previous fiscal year. The total income was $3,566,411, against $3,428,215, and the surplus $2,348,137, against $2,343,956. The gross earnings of the Pittsburg Railways Company were $9,512,670, against $8,569,476, the net earnings $3,984,659, against $3,418,832, and the surplus $42,946, against a deficit of $281,551 for the previous year.

Extensive Plant Being Built by the John A. Roebling's Sons Company.

The John A. Roebling's Sons Company is building an extensive plant near Kinkora, N. J. The three large mills which are being erected will give employment to some 3,000 men. There will be a model hotel and restaurant, forty-eight houses with all modern conveniences, seventy-two medium-grade houses, ninety houses in blocks of ten, and 600 detached houses. The streets will be 100 feet wide, paved, and will be beautified with parkways and shade trees. There will be an assembly hall, a park, school and athletic field. The company will maintain a filtered water supply, will furnish street and hotel lights, will maintain the property, and attend to the disposition of garbage. The rental of the various houses, which have been built to accommodate the several grades of workmen, will be low, as the company does not desire a profit from this part of the enterprise. The plans for the building of the city have been carried out entirely in the office of the Roebling company. Charles G. Roebling, president of the company, has devoted the greater part of his energy for the last year to carrying out this project, and under his direction Isaac Harby has taken care of the details.

Improvements in the Mercury Vapor Lamp.

It was said by Herren E. Gehrcke and O. von Baeyer in the *Elektrotechnische Zeitschrift* recently that the light given by the mercury vapor lamp can be improved by adding other substances, such as zinc, to the electrodes of the lamp. One lamp having electrodes of zinc amalgam was tested, the proportion of zinc being about three times that of the mercury. The spectrum showed, in addition to the mercury lines, four zinc lines, the red zinc line being particularly strong. This lamp gave light which was said to resemble daylight more nearly than that of the

ordinary mercury vapor lamp. Red bodies showed their proper colors, but the human skin appeared rather red. Yellow articles were too red or too green. By adding a little sodium to the zinc amalgam the sodium lines were brought out and the light was then similar to that given by the flame arc lamps. A disadvantage of the amalgam is its tendency to solidify and thus crack the globe; but this can be prevented by adding ten per cent of bismuth. The spectrum of the latter metal has no apparent effect on the light. The lamp is said as yet not to be suitable for commercial use.

Adjustable Electric Chandelier Fixtures.

The Adjustable Fixture and Manufacturing Company, Greenville, Ohio, is placing on the market a line of adjustable fixtures, some of which are shown in the accompanying illustrations. Fig. 1 and Fig. 2 show a device for coiling and uncoiling electrical conductors. The apparatus shown in the accompanying figures is made to coil and uncoil fifty feet of conductor. Fig. 1 shows the conductor unwound from the drum. The larger drum

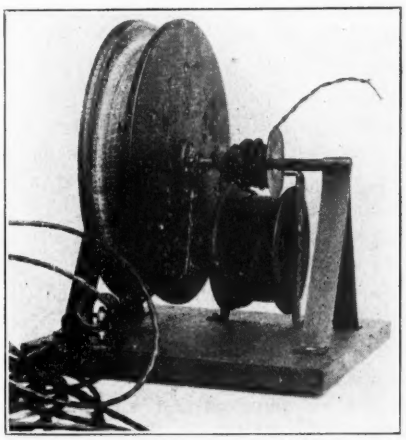


FIG. 1.—DEVICE FOR COILING ELECTRICAL CONDUCTOR.

has a spring in it that winds up the conductor. The smaller drum is used to keep taut the cord on the small drum and to prevent it from becoming twisted, and has the reverse action of the larger drum. A complete circuit is maintained at all times. There are no sliding contacts, and the electrical conductors are continuous and in one position. This is an application of the principle under patent No. 800,049, issued to H. C. Ayres, and owned by the company.

Fig. 3 is an application of this principle to a chandelier, allowing the centre light to be raised or lowered from thirty to thirty-six inches. The cord is run through the stem, and there is a tension in the body of the chandelier to control the movement of the light, so that it can be adjusted at any point. This enables the

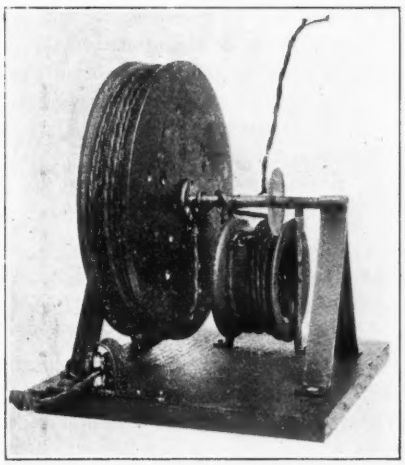


FIG. 2.—DEVICE FOR COILING ELECTRICAL CONDUCTOR.

placing of the lamp so that the light can be thrown on a reading table, and at the same time a small candle-power unit employed. The chandelier is intended pri-

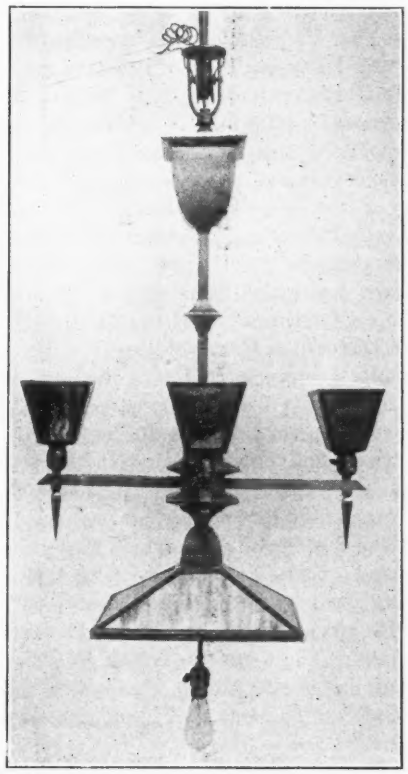


FIG. 3.—CHANDELIER WITH ADJUSTABLE CENTRE LAMP.

marily for general illumination, and is, of necessity, placed high up in the room. The use of this device obviates the necessity of a cord and stand lamp. Fig. 4 is also an application of this suspension principle.

The company is also the owner of a number of patents covering metal mouldings for interior electric conductors. The principal advantage of this method is the ease with which the covering is attached and detached. The cover is rigid, and the slides can not be crushed in or pressed outward after the casing is once put on.

The company also makes a cord ad-

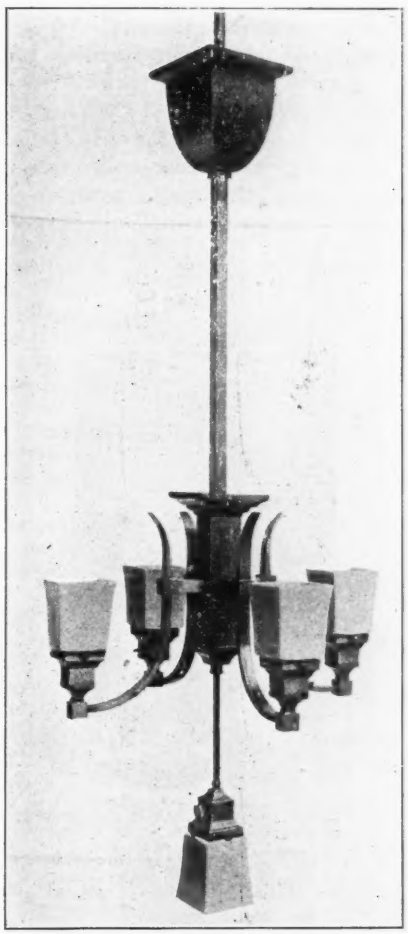


FIG. 4.—CHANDELIER WITH ADJUSTABLE DROP LIGHT.

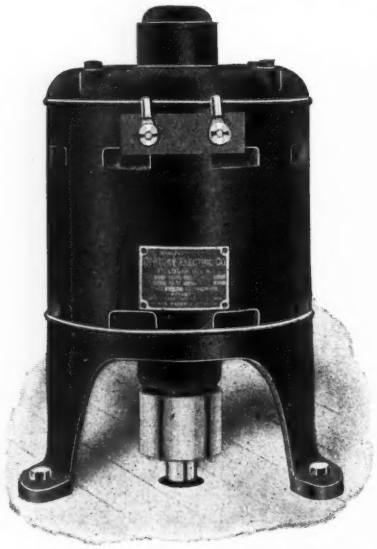
juster, composed of two short leather strips. One end of these leather strips is eyeletted to receive the cord, and the opposite ends are fitted with a button and receptacle for making fast after the cord has been brought to proper adjustment.

The officers of this company are: D. L. Gaskill, president; W. S. Meeker, secretary; George W. Sigafoos, treasurer, and H. C. Ayres, manager.

Single-Phase, Alternating-Current Motors.

The Century Electric Company, St. Louis, Mo., has placed on the market a line of single-phase, alternating-current motors, an illustration of which is shown herewith. These motors are self-starting under full load and are automatic in op-

eration. The operator has simply to close a double-pole knife switch, which may be located at any convenient point, no matter how far distant from the motor. While running up to speed the induced current in the armature is short-circuited through the carbon brushes bearing on the commutator, so situated with relation to the field as to control the direction of rotation and the amount of starting torque. On reaching full speed the governor weights are thrown out due to centrifugal force, short-circuiting every commutator bar to one common ring of high conductivity, and at the same time releasing the tension on the carbon brushes and pushing them back away from the commutator, allowing the motor to run as an induction motor. The governor is



VERTICAL TYPE SINGLE-PHASE MOTOR.

automatic, and, when the motor is stopped, the device returns to its original starting position.

These motors are wound and carried in stock for 104 and 208 volts. They can be operated on either of these voltages by changing the connections on a terminal board located inside the motor. When so wound they will be found to give satisfaction, it is stated, on circuits having a voltage between 100 and 120, and between 200 and 240 volts, respectively.

While these motors are primarily intended for use on single-phase circuits, they may be operated off any one phase of a two or three-phase circuit.

The standard form of construction gives the motor proper protection, and at the same time allows sufficient ventilation to permit the motor carrying heavy loads continuously without an abnormal temperature rise. The manufacturer states that the best material and workmanship are employed, and all parts are of heavy design. The bearings are of large dimensions, the best phosphor bronze being used in their construction. The oil wells are of ample capacity to hold sufficient oil for several weeks' run. These motors may be furnished with back-geared shaft and gears mounted on the side of the machine. The bearings carrying the back-geared shaft are the same as those used on the armature shaft and are self-oiling. Vertical motors are arranged so that no oil will drip into the winding of the motor.

The Report of the General Advancement Committee of the Electrical Salesmen's Association.

The General Advancement Committee of the Electrical Salesmen's Association has been carrying on a campaign of enquiry among the members, requesting suggestions as to topics for papers and for ideas looking to the upbuilding of a strong and dignified organization. The following is a partial list of the topics for papers suggested by members. Some interesting speakers have already been obtained: "On the Essentials to Be Kept in Mind when Approaching a Stranger for a Purely Business Interview"; "Arousing an Interest in Your Proposition"; "Securing Material for a Persuasive Talk"; "The Elements of Talking Convincingly with Logical Expression"; "On the Elements of a Successful Impromptu Address Before an Assemblage Such as a Municipal Council or State Board"; "Scientific Salesmanship"; "The Proper Method of Criticising Competitors' Arguments"; "Choosing the Most Successful Time for an Interview and a Consideration of the Proper Time to Discuss the Matter of Terms"; "Points to Be Avoided in Closing a Business Arrangement"; "On the Relation Between Character-Building and Business-Getting Persuasion"; "Is a Salesman Born or Made?" "Practical Lines of Co-operative Work on the Part of Electrical Salesmen"; "The Pushing of Specialties"; "Salesmanship"; "Price as Compared with Quality as a Basis for a Sale of Electrical Goods"; "Requirements of an Electrical Salesman"; "The Course to Pursue in Soliciting the Business of a Prospective Customer"; "The Buyer's Side of the Question."

The Electrical Salesmen's Association has now a membership of 300, and is represented in Mexico, the Philippine Islands, Canada and England. The secretary, George H. Erich, 401 Monadnock Block, Chicago, Ill., will be pleased to receive communications from salesmen.

Experiments on the Inductive Vienna-Innsbruck Telephone Line.

The following is a summary given by *The Electrician,* London, of a discussion by Herr R. Nowotny of the results obtained by the use of the Pupin system of loading telephone lines, which is being tried on the Vienna-Innsbruck, Austria, line:

The distance between Vienna and Innsbruck is 354 miles, and the telephone wire consists for the greater part of three millimetres (0.1181 inch) bronze wire. Inductance coils were inserted at intervals of four kilometres (2.48 miles). At the very outset it was observed that the transmission did not suffer appreciably if every second inductance coil was cut out. This result was confirmed by subsequent tests of long duration. In the autumn of 1905, the Innsbruck-Trient line (109 miles long and of three millimetres bronze wire) was connected up to the Vienna-Innsbruck line. This extension was also provided with inductance coils at intervals of 2.48 miles. When all the inductance coils between Vienna and Trient (463 miles) were short-circuited, it was possible to maintain satisfactory communication between Vienna and Bozen (430 miles), but communication between Vienna and Trient was difficult and only possible by talking slowly and distinctly. But a satisfactory service between the subscribers at Vienna and Trient became possible at once when the inductance coils were inserted, and no appreciable difference was found whether the coils were 2.48 miles or 4.96 miles apart. The overhead telephone line Trient-Riva (thirty-three miles long, three millimetres bronze wire, no inductance coils) was then connected up also, and it was observed that with inductance coils 4.96 miles apart (between Vienna and Trient only) an indifferent communication could be carried on between Vienna and Rovereto (13.6 miles beyond Trient), but no further. It is noteworthy that no better result was obtained when all the inductance coils (at intervals of 2.48 miles) were inserted. After inductance coils had been inserted in the Trient-Riva line at intervals of 4.96 miles, it was possible to communicate satisfactorily between Vienna and Riva (496 miles). In view of these results the Austrian telephone authorities decided to remove half of the inductance coils between Vienna and Trient.

A further series of tests were carried out between Vienna and St. Pölten (37.2 miles) to determine whether the efficiency

of transmission was impaired or not by placing the inductance coils at irregular distances. It was observed that the effect was the same whether the coils were at regular or irregular intervals. This was further confirmed by the fact that the transmission between Vienna and Innsbruck did not suffer appreciably if the inductance coils on the section between Salzburg and Bischofshofen (18.6 miles) were removed altogether.

It would appear that inductive telephone lines are more sensitive to extraneous electric influences than lines not provided with induction coils. The disturbances caused by strong telegraphic currents in telegraph lines parallel to the above telephone line were more pronounced, for instance, than if the telephone line had had no inductance coils. Insulation faults also led to greater disturbances in the case of inductive telephone lines, but a uniform leakage (as occasioned, for example, by wet weather or fog) had no marked influence on telephonic transmission. In the section between Vienna and St. Pölten the disturbances due to exterior sources (tramways, etc.) were appreciably increased by the presence of even a single inductance coil, and it was also observed that the disturbances were larger or smaller according to which coil was left in the circuit. Some of the coils, for instance, led to small disturbances, while others conduced in a remarkable manner to disturbing noises.

On investigation it was found that the self-induction of the coils had decreased from the original value of 0.08 henry to much smaller values. Most of the coils had a coefficient of self-induction between 0.05 and 0.06 henry, while in some it was as low as 0.03 henry. This effect is put down to the remanent magnetism produced by powerful temporary currents, such as may occur in testing by continuous current, or may arise from lightning effects. The self-induction could be increased in almost all cases to two-thirds its original value by demagnetizing the coil with powerful alternating currents.

Annual Convention of the Indiana Independent Telephone Association.

The Indiana Independent Telephone Association held its annual convention at the Claypool Hotel, Indianapolis, Ind., May 17 and 18. The association is composed of officers and managers of the independent telephone companies throughout the state. George W. Beers, Fort Wayne, is president, and Charles S. Norton, of Indianapolis, is secretary-treasurer. The executive committee is composed of these officers and A. C. Foster, Terre Haute; A. C. Lindemuth, Richmond; Theodore Thorward, South Bend; V. P. Frieburg, Lafayette, and J. W. Weik, Greencastle.

Annual Meeting of the American Institute of Electrical Engineers.

The annual meeting of the American Institute of Electrical Engineers was held on the evening of Tuesday, May 15, at the library of the Edison Assembly Rooms, 44 West Twenty-seventh street, New York city. The meeting was called to order by the president, Dr. S. S. Wheeler, who declared the reading of the minutes of the last annual meeting passed over, and called for the report of the committee of tellers for the vote upon officers for the year 1906-1907, and for the vote of the membership on the constitutional amendments. After reading the report of the tellers, President Wheeler declared Dr. Samuel Sheldon elected president.

Vice-presidents were elected as follows: A. H. Armstrong, H. H. Humphrey, F. G. Baum.

Managers were elected as follows: Paul M. Lincoln, Paul Spencer, J. J. Carty, A. M. Schoen.

Upon motion of F. C. Bates the reading of reports of all other committees and the reading of the report of the board of directors were dispensed with, and the reports of these committees accepted.

F. C. Bates and John J. Carty congratulated the Institute upon the election of Dr. Sheldon, and C. B. Burleigh, Charles F. Scott, C. O. Mailloux, Dr. F. A. C. Perrine, H. G. Stott and Dr. Wheeler spoke upon the necessity of definite action being taken by the Institute with regard to improving conditions among the local branches of the Institute. These gentlemen also discussed the possibility of again submitting to the membership a ballot upon the constitutional amendments. These amendments were lost. The vote was overwhelmingly in favor of the adoption of the new constitution, but failed of passage because the total number of votes received did not form a majority of the qualified members of the Institute. It was the sense of the meeting that this was due to lack of knowledge and indifference on the part of the membership. It was suggested by several present that the matter of submitting a new ballot to the membership be taken up by the board of directors, and that every effort be made to arouse interest in the growth and development of the Institute and arrange for a constitution that would properly take care of the advancement which has been made in recent years.

A vote of thanks was heartily tendered to the New York Edison Company for placing its assembly rooms at the service of the Institute, and also to the New York Telephone Company for its courtesy in turning over its board room for the meetings of the directors of the Institute.

The report of the board of directors for the fiscal year ending April 30, 1906, showed total membership of 3,870. The total assets of the Institute were $156,472.27. The total liabilities were $101,160.33, leaving a surplus of $55,311.94.

The library committee reported that during the year the library had received from the International Electrical Congress of St. Louis a fund of $2,052.67, representing the profits from the sale of transactions of the congress. In accordance with the deed of gift, the annual proceeds of this fund are to be devoted solely to the purchase of international electrical literature.

The bibliography of the Wheeler gift, which has been in preparation for the past four years, is now complete, and within a few weeks the manuscript will be placed in the hands of the printer. The preparation of this work, which includes bibliographic annotations of more than 5,000 titles of books and pamphlets, represents a vast amount of labor on the part of Brother Potamian, to whom a great debt of gratitude is due for the scholarly and exhaustive manner in which he has acquitted his arduous task. The work will form a large octavo volume and will undoubtedly take high rank in the literature of bibliography. According to the Wheeler deed of gift, every member of the Institute will be entitled to a copy.

The total valuation of the library on May 1, 1906, including permanent library fixtures, was $26,674.76, divided as follows: books, $22,069.31; book stacks, $1,470.25; furniture, catalogue cases, etc., $135.20. The Institute appropriations for library purposes during the past year were $3,051.25. Of this amount there is an unexpended balance of $356.81.

There being no further business, the meeting was adjourned.

The National Electrical Contractors' Association.

The sixth annual convention of the National Electrical Contractors' Association will be held at Cleveland, Ohio, July 18, 19 and 20. The headquarters will be at the Hollenden Hotel. The Central Passenger Association has granted excursion fares from all points in its territory, excepting from Ohio, for passengers attending the convention. Alexander Henderson, master of transportation, 39 Cortlandt street, New York city, has ready for distribution bulletin No. 3 and bulletin No. 4, giving full information concerning railroad fares and accommodations.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

TO TAKE UNION TRACTION COMPANY OUT OF RECEIVERSHIP—President Mitten, of the City Railway Company, Chicago, Ill., is said to be working on a plan to unify both traction companies and to take the Union Traction Company out of receivership, which is costing the company about half a million yearly.

ORGANIZATION OF THE NEW YORK CAR AND TRUCK COMPANY—The New York Car and Truck Company, a $2,500,000 concern, has been incorporated to manufacture railway and street cars, carriages, etc. The stock is divided into $500,000 six per cent preferred and $2,000,000 common. The incorporators are: John H. Turner, Harry S. Rosswell and Thomas S. Strong, Jr., Jersey City, N. J.

REORGANIZATION OF THE ONEONTA, COOPERSTOWN & RICHFIELD SPRINGS RAILROAD—The Oneonta & Mohawk Valley Railroad, a reorganization of the Oneonta, Cooperstown & Richfield Springs Railroad, operating in New York state, has been incorporated with the secretary of state with a capital of $1,800,000. The directors are: G. A. Auer, H. F. Parr, of New York, and others.

MEXICAN TELEGRAPH COMPANY—At a special meeting of the stockholders of the Mexican Telegraph Company the proposition to increase the capital stock from $2,000,000 to $3,000,000 was approved. The $1,000,000 of new stock will be distributed to the stockholders as a fifty per cent stock dividend. It is issued on account of capital expenditures extending over several years up to December 31, 1905.

OHIO TRACTION DEAL—An important traction deal has been closed by the Widener-Elkins syndicate taking over the control of the Dayton & Northern Traction Company and the Dayton & Muncie Traction Company. This accession gives the syndicate a through line from Indianapolis to Columbus. The syndicate already owns the Union Traction lines, of Indiana, and will connect with the Dayton & Muncie at Muncie, and make an Indiana line out of the road to Union City, Ind. From there to Columbus it will be an Ohio road.

REPORT OF THE MANILA ELECTRIC RAILROAD AND LIGHTING CORPORATION—The general balance sheet of the Manila Electric Railroad and Lighting Corporation for December 31, 1905, shows assets of $10,038,000. Adding to this expenditures for improvements, additions, etc., of $610,081; cash, $131,590, and current assets of subsidiary companies, $183,527, makes a total of $10,963,199. The liabilities include capital stock of $6,000,000; bonds, $4,635,000; accrued interest, $77,250; current liabilities of subsidiary companies, $30,779, leaving a surplus of $220,170.

SIGNOR MARCONI PROMISES WIRELESS ATLANTIC COMMUNICATION—Signor Marconi has assured the shareholders of the British Marconi Company that wireless communication between America and Great Britain will be thoroughly established for commercial purposes by next September. It is announced that the station at Cape Breton, Nova Scotia, is in daily unbroken communication with the Poldhu, Cornwall, station. The European station, however, will be located in County Galway, Ireland. Marconigrams will be accepted at twelve cents a word, with reductions for press and government messages.

INCORPORATION OF THE PACIFIC LIGHT AND POWER COMPANY—The Pacific Light and Power Company, with H. E. Huntington as its president, and with a capital stock of $10,000,000, has filed articles of incorporation at Bakersfield, Cal. This is taken to mean that there is to be an early movement in the direction of building an electric line from Bakersfield to the coast. It is understood that the Pacific Light and Power Company will include in its property the Kern River plant at Kernville. Besides Mr. Huntington the other incorporators are: I. W. Hellman, A. Borel, Charles D. H. Guigne, William Hershoff and Kaspare Cohn.

HEARING ON THE APPLICATION OF THE ATLANTIC TELEPHONE COMPANY—A hearing on the application of the Atlantic Telephone Company for a franchise came up before the Board of Estimate, of New York city, on Friday, May 11. The Atlantic Telephone Company announced that it would give an unlimited service for two cents a call. The company's representatives were supported by many prominent men in the independent telephone field. The counsel for the New York Telephone Company presented the petitions of 4,000 business and professional men protesting against the installation of a duplicate system. Both sides of the controversy were given one week in which to submit briefs.

LOUISVILLE (KY.) TRACTION DEAL—A traction deal involving more than $750,000 and the sale of the largest interurban road operating out of Louisville, Ky., has been consummated by a syndicate of Louisville and Indianapolis capitalists. It is also stated that approximately $2,000,000 has been raised through the financing of a Boston banking house for the extension of the present road to Frankfort, Ky. The road sold is known as the Louisville & Eastern, and operates in the Pewee valley. It is owned by H. H. Bechtel, of the American Oak Leather Company, of Cincinnati, Ohio, and a number of associates. The purchasers are: F. M. Fauvre, C. E. Elliott and Harry B. Gates, of Indianapolis, and Percival Moore, of Louisville.

FRANCHISE DECISION ADVERSE TO THE BROOKLYN RAPID TRANSIT COMPANY—A decision of great importance to the traction interests of Brooklyn, N. Y., was handed down on May 8 by the Court of Appeals, affirming the judgment of Justice William J. Kelly, that a franchise to construct a railroad on Saratoga avenue, from Broadway to the old city line, was invalid. The invalidity lay in the fact that the Brooklyn Rapid Transit Company and its subsidiary and operating companies has not begun operations within five years. The city has begun suit to declare old-time franchises granted the subsidiary companies of the Brooklyn Rapid Transit Company, on which work has not been finished within ten years, invalid.

BALTIMORE LIGHT COMPANIES PLAN CONSOLIDATION—Negotiations are under way for the merger of the Consolidated Gas, Electric Light and Power Company, of Baltimore, Md., with the Consolidated Gas Company, of the same city. This combination has been made possible by the recent act of the legislature of Maryland. A committee representing stockholders of the Consolidated Gas Company, consisting of N. W. Williams, chairman; S. S. McKim, H. C. McComas, of Baltimore; Oakleigh Thorne, George W. Young and George H. Prentiss, of New York, has consented to act in behalf of the minority stockholders to investigate any plan which may be submitted, and to secure just participation for the minority interests. The Trust Company of America, of New York, and the Fidelity Trust Company, of Baltimore, have been selected as depositaries.

MERGER OF LIGHT AND POWER PLANTS IN COLORADO—By the payment of $250,000 the Northern Colorado Power Company has acquired the holdings of the Boulder Light and Power Company, including the six miles of street railway operated by the company, as the preliminary steps toward the consolidation of a number of the electric plants in northern Colorado and southern Wyoming towns. The announcement of the purchase of the Boulder, Col., electric plant by the newly organized power company has followed closely upon the determination of the Colorado & Southern Railroad officials to electrify the line between Denver, Boulder, Fort Collins and Greeley. The object of the new company is not only to furnish power to the Colorado & Southern, but to the numerous mines in the territory to which its lines will extend. It is the intention of the power company, also, to take over the Cheyenne and Fort Russell electric light and gas plants of the utility company there, and also the Consumers' company's plant at Lafayette, which supplies Lafayette, Superior and Erie with light. The payment, it is expected, will be $450,000. The company will discontinue the Boulder plant as soon as a new 10,000-horse-power plant can be erected at Lafayette. Ultimately the Lafayette plant will have a

capacity of 35,000 horse-power. The Northern Colorado Power Company will be reorganized with a capital stock of $3,000,000.

SETTLEMENT OF THE NATIONAL ELECTRIC COMPANY BANKRUPTCY—A dividend of five per cent has been paid on forty-one contingent claims against the National Electric Company, Milwaukee, Wis., on notes endorsed by Frank G. Bigelow amounting to $880,325.73, making the total amount of payments $44,916.29. These notes had been purchased by the Standard Trust Company, of New York, acting for the reorganizers of the company. The total of proved claims against the estate amounted to $1,096,726.71. The total receipts of the National Electric Company from the filing of a petition in bankruptcy until the final disposal of the company aggregated $1,503,500.83, as announced in the last report of the trustee, John I. Beggs. The disbursements amount to $1,386,941.55, leaving a balance of $116,559.28. There still remains to be paid, however, $80,009.41 of the latter amount. The trustee's fees, amounting to $15,185, are to be deducted. The trustee's solicitor is to receive $5,506.50, and there is a balance unpaid of the fees of the referee in bankruptcy. Included in the items of expense unpaid is the adjusted claim of N. A. Christensen, which was settled for $26,000.

ELECTRIC PROPERTIES COMPANY ORGANIZED—The Electric Properties Company, of New York city, has been incorporated with a capital of $12,000,000, of which one-half is six per cent cumulative preferred. The directors are: Paul D. Cravath, Charles H. Allen, H. S. Giddings, N. W. Halsey, Moses Taylor, Frank D. Underwood, Robert B. Van Cortlandt and John F. Wallace, of New York city; George Westinghouse and George C. Smith, of Pittsburg, Pa.; John A. Spoor, of Chicago, Ill., and E. G. Tillotson, of Cleveland, Ohio. The certificate subscribers are: Amasa J. Parker, Jr., and Charles E. McElroy, of Albany, N. Y., and Joseph P. Cotton, New York city. The purposes of the new company, as defined in its certificate of incorporation, are to acquire, finance and develop properties, especially those in which electricity plays the principal part, such as electric traction and electric lighting enterprises; and to invest, deal in and guarantee the securities of corporations owning or operating such properties. The company has acquired the entire capital stock of Westinghouse, Church, Kerr & Company. The following officers have been elected: president, John F. Wallace; vice-presidents, George C. Smith and P. F. Thompson; secretary and treasurer, W. A. Esselstyn. An executive committee has been appointed, to consist, in addition to the president, of Charles H. Allen, Paul D. Cravath, N. W. Halsey, Frederick D. Underwood and Robert B. Van Cortlandt.

PERSONAL MENTION.

MR. C. E. F. AHLM, consulting and designing engineer, has removed his offices to 614-615 Caxton Building, Cleveland, Ohio.

MR. C. F. HEINKEL, who has been general designer for the Elwell-Parker Electric Company, Cleveland, Ohio, has been appointed to the position of chief draughtsman.

MR. H. H. KIRKPATRICK has retired as general manager of the Watauga (Tenn.) Lighting and Power Company, and will undertake the building of a street car line at Tampa, Fla.

MR. ELLIOTT REYNOLDS will represent the Doubleday-Hill Electric Company, Pittsburg, Pa., at the convention of the National Electric Light Association, Atlantic City, N. J., June 5-8.

MR. LOUIS F. REED, counsellor-at-law, and son of H. A. Reed, president of the Bishop Gutta Percha Company, announces the removal of his office to the Singer Building, 149 Broadway, New York city.

MR. JAMES H. HESSIN, Huntington, Ind., has been appointed superintendent of the Pontiac (Ill.) Light and Water Company, and also general manager of the Bloomington, Pontiac & Joliet Electric Railway Company, succeeding Mr. Fred L. Lucas.

MR. W. N. ZURFLUH, superintendent of the Home Lighting, Power and Heating Company, Springfield, Ohio, has resigned and will go to Dayton, Ohio, to become superintendent of the electric lighting plant in a new business building in Dayton.

MR. JAMES W. BOWLING, of Clarinda, Iowa, will succeed J. P. Mason as manager of the Fort Madison exchange of the Iowa Telephone Company. Mr. Mason has accepted a position in the office of Superintendent C. E. Hall, at Des Moines, as service inspector.

PROFESSOR SAMUEL SHELDON has been elected president of the department of electricity of Brooklyn Institute, Brooklyn, N. Y. It has been planned to materially increase the work of this department next season in a series of lectures that shall be both technical and popular.

MR. IRVING B. CARY has been appointed for a five-year term on the Milwaukee, Wis., lighting commission by Mayor Becker. In addition to Mr. Cary the following persons are named: Robert Hill, four years; Michael Kruszka, three years; Fred Landeck, two years; and Caspar Kroeger, one year.

MR. RICHARD McCLATCHEY will retire on June 1 from the post of assistant superintendent of the bureau of electricity, Pittsburg, Pa. Mr. McClatchey has been an employé of the city of Pittsburg since 1873. For some time he has been devoting himself to the fire-alarm feature of the work of the bureau. He practically has this branch of the work in charge.

MR. CHARLES S. JOHAN has resigned from the post of general superintendent of the People's Light, Heat and Power Company, of Springfield, Ohio. He will be succeeded by Byron H. Clingerman, a well-known local electrical engineer. Mr. Clingerman is a graduate of the Massachusetts Institute of Technology, and was at one time connected with J. G. White & Company, of New York city, later becoming electrical engineer for the Appleyard system of traction lines. He is at present engaged in consulting engineering.

MR. ALLARD SMITH, superintendent of construction of suburban territory for the Chicago Telephone Company, recently delivered a lecture before the engineering students at Wisconsin University, on the opportunities in the telephone field for young engineers, and the character of training which they were subjected to. As an example of the engineering met with in telephone work, Mr. Smith described the construction of an underground conduit and cable system from Chicago to Kenosha, forty miles in length, which will be taken up during this year.

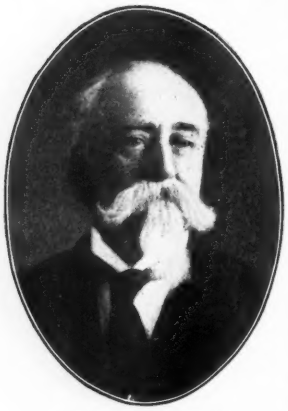
MR. WILLIAM CLEGG, JR., who has been special agent of the Westinghouse Electric and Manufacturing Company in its St. Louis (Mo.) territory, has received the appointment of acting manager of the St. Louis office. Mr. D. E. Webster, formerly manager of the office, has been transferred to a position in the Chicago sales office. Mr. J. S. Tritle has been appointed acting manager of the new district office opened by the Westinghouse company in the New England Building, Kansas City, Mo. Mr. Tritle was formerly connected with the St. Louis office.

MR. J. W. DUNTLEY, president of the Chicago Pneumatic Tool Company, sailed for Europe on May 3 in the interest of the company's business. Conditions in Europe and on the Continent are improving rapidly, and a number of large contracts which have been pending are ready to be closed. Several contracts will be awarded to the Consolidated Pneumatic Tool Company, Limited, London, the foreign branch of the Chicago company, for extensive installations. Before sailing Mr. Duntley stated the domestic business was entirely satisfactory and considerably heavier than at the same time last year.

MR. G. R. NEWCOMER, who was for years connected with the Columbia Incandescent Lamp Company, in charge of its Memphis (Tenn.) office, has accepted the position of district manager with the Brilliant Electric Company, Cleveland, Ohio. Mr. Newcomer will take charge of the selling organization in the Middle West, West and South, with temporary headquarters at Kansas City. He has been in the electrical business since 1893, during which time he has covered the greater part of the United States in the interest of the largest electrical concerns in the country. For several years he was in charge of the selling organization of the United States Carbon Company.

OBITUARY NOTICE.

MR. ROBERT J. SHEEHY, who died on April 26, was born in Ireland in 1843, coming to this country with his parents in 1847, and settling in New York. In 1854 he entered the telegraph service as a messenger. For a short time he left the service, returning in 1862, being employed by the old American Telegraph Company as a line builder in New England. In the beginning of 1865 he accepted a position with the Insulated Telegraph Company, and in 1867 secured a position as a lineman with the Western Union Telegraph Company. In August, 1868, he became connected with the Franklin Telegraph Company, whose lines extended from Boston to Washington. Leaving the Franklin company in 1871 Mr. Sheehy went to Boston with Sewell Smith, with the newly organized Gold and Stock Telegraph Company. Mr. Sheehy was general utility man, lineman, builder, inspector, battery man solicitor and collector. In 1875 Mr. Sheehy left this company and settled down to experimenting and constructing telegraph instruments, motors and other electrical appliances. In 1878 he engaged with C. M. Rowley and Thomas J. Montgomery, of Boston, agents for the Brush system in New England. In July of that year he installed the first Brush plant in the Mechanics' Charitable Fair, Boston. At the opening of the fair he had two four-light dynamos installed, which lighted a portion of the building. At the conclusion of the fair Mr. Sheehy put a four 3,000-candle-power light arc dynamo in Washburn & Moen's rolling mills in Worcester. Following this a six-arc-light plant was placed in the clothing house of Freeland, Loomis & Company, of Boston, Mass., and later an eighteen-lamp machine was installed in the Merrimac mills at Lowell, Mass. A plant was then put in operation in the Willimantic Linen Company's mills at Willimantic, Ct., and one in the Conant Thread Company's works at Pawtucket, R. I. Mr. Sheehy installed a plant which had much to do with establishing the practicability of the Brush system, in the Riverside Worsted Mills, Providence, R. I. The arc lamps proved so satisfactory that the size of the installation was increased until there were over seventy arc lamps in the mills. In the summer of 1879 Mr. Sheehy placed a six-light machine at Nantasket Beach, to light the grounds of the Nantasket Beach Hotel. In the spring of 1879 the New England agents formed a company known as the Brush Electric Lighting Company of New England, and shortly afterward acquired the agency for the New York and Pennsylvania territories. In the fall of 1879 an office was established in New York. The first arc plant was placed in A. D. Julliard's store, and later with Dunham, Bulkley & Company and with Bates, Reed & Cooley. At this time Mr. Sheehy brought to Mr. Julliard's attention the idea of forming a company in New York, and a number of gentlemen were brought together for that purpose, but the scheme fell through. In April and May, 1880, Mr. Sheehy was engaged in arranging an electrical plant on the steamer Massachusetts, and in testing electric searchlights for sea-going purposes. Mr. Sheehy severed his connection in the east in 1882, taking the agency for the Brush system for the southern territory. In Washington he made an exhibit of tower lighting, placing lights on the Washington monument, around the base of the Goddess of Liberty, on the dome of the Capitol, and on the tower of the Smithsonian Institute. In 1885 Mr. Sheehy returned to the business he had started in Boston in 1876 and 1877, experimenting in telegraphic apparatus. He devised and improved apparatus of various kinds, until he successfully invented and patented instruments for local and long-distance exchange purposes, printing-telegraphs for private lines, for quotation and general news service. He invented a multiplex system, and autograph or copying telegraph instruments. An important invention was a synchronizing system for trunk line business between large centres. In 1890 he organized the Equitable Manufacturing and Electrical Company. In later years Mr. Sheehy concentrated his attention on the invention of a series of electrical devices intended to ensure economy and safety in railway work. About three years ago he exhibited in this city a complete working model of an electric railway signal system, including danger signals on the locomotive, despatcher's operating signals, interlocking devices for controlling trains at a distance, and a block-by-block section clearing system. Mr. Sheehy is survived by a widow.



MR. ROBERT J. SHEEHY.

EDUCATIONAL.

HYDRAULIC LABORATORY AT THE UNIVERSITY OF WISCONSIN—The new hydraulic laboratory for the University of Wisconsin is practically completed and will soon be used by students for experimental purposes. The laboratory is equipped for investigation of problems of water power and water supply. It is located on the shore of Lake Mendota, near the College of Engineering, and immediately adjoining the university pumping station and tank house. The building is constructed of reenforced concrete. It is forty-eight feet by ninety-eight feet, three stories high, including the basement.

COMMENCEMENT WEEK AT PURDUE UNIVERSITY—On Sunday, June 3, the baccalaureate address will be made at Purdue University, Lafayette, Ind., by James B. Angell, president of the University of Michigan. On Monday, June 4, the annual exhibit of the art department will be held, and all departments and buildings opened for inspection. The ball games will be held between the alumni, 'varsity, faculty and seniors. At 4 P. M. a musical recital will be held in Fowler Hall. In the evening class and fraternity reunions will be held. On Tuesday, June 5, there will be class day exercises of the senior class in the morning. The ball game between Purdue and the University of Minnesota will be opened at 3 P. M. At 8 P. M. the annual meeting of the Alumni Association will be held. From 8 to 11 P. M. the official reception in honor of alumni, graduates and guests will be held in Agricultural Hall. On Wednesday, June 6, the graduating exercises will be held in Fowler Hall at 9.30 A. M. Abstracts of theses by members of the graduating class will be presented, an address will be made by Professor Albion W. Small, of the University of Chicago, and degrees will be conferred.

NEW PUBLICATIONS.

CATALOGUE AND REPORT OF THE HEBREW TECHNICAL INSTITUTE—The catalogue and report of the Hebrew Technical Institute for the year 1906 is ready for distribution. This report and catalogue shows a very satisfactory condition of affairs, and describes the very worthy work which the members of the Hebrew Technical Institute Society, of New York city, are carrying on.

CHATTANOOGA, THE MOUNTAIN CITY—The Chattanooga & Tennessee River Power Company, Chattanooga, Tenn., has issued a souvenir volume entitled "Chattanooga, the Mountain City," which was compiled for the spring meeting of the American Society of Mechanical Engineers, held at Chattanooga, May 1-4. The book is replete with handsome illustrations, and the text is interesting and instructive. A map of Chattanooga and vicinity supplements this handsome volume, which was compiled by Mr. Thomas E. Murray, general manager of the New York Edison Company.

ENGINEERING SOCIETIES.

AMERICAN SOCIETY OF MODEL ENGINEERS—The American Society of Model Engineers will hold its next meeting at the Berkeley Lyceum, 19 West Forty-fourth street, New York city, on Wednesday evening, May 23. All parties interested in model work are invited to attend. The secretary of the society is Mr. W. E. Spon, 123 Liberty street, New York city.

BALTIMORE BRANCH, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—The Baltimore (Md.) branch of the American Institute of Electrical Engineers held a meeting in the physical laboratory of Johns Hopkins University, Friday evening, May 11, and listened to a paper on "The Discharge of Electricity Through Gases," by Professor R. W. Wood. This gave a résumé of the theory of electrons.

NEW INCORPORATIONS.

COLUMBUS, OHIO—The Adamsville Telephone Company, Muskingum county. Increase of capital stock from $3,000 to $10,000.

COLUMBUS, OHIO—Tuscarawas County Telephone Company, New Philadelphia. Increase of capital from $200,000 to $250,000.

ST. LOUIS, MO.—Independent Electric Company. $10,000. Incorporators: John Dowd, George J. Clark and E. F. Cunningham.

MADISON, WIS.—The Milwaukee Telephone Company, Milwaukee. $100,000. Incorporators: Bernard C. Roloff, Charles L. Goss and Paul Stover.

SPRINGFIELD, ILL.—Murphysboro Telephone Company, Murphysboro. $10,000. Incorporators: A. B. Minton, Thomas M. Logan and W. C. Alexander.

COLUMBUS, OHIO—Todd Corners Telephone Company, Wakeman. $3,000. Incorporators: C. H. Todd, M. I. Todd, W. H. Hayes, A. J. French, F. M. Arnold and M. E. D. Greene.

GUTHRIE, OKLA.—The Farmers' Telephone Company, Noble, Okla. $1,000. Officers and directors: A. L. Lewis, president; A. Flitner, vice-president, and A. J. Burkett, secretary and treasurer.

COLUMBUS, OHIO—Cleveland, Ashland & Mansfield Railway Company. To build an electric line from Ashland to Mansfield. $500,000. Incorporators: G. A. Bartholomew, Theodore W. Farham, A. M. Slentz, E. S. Avery and William H. Kees.

SPRINGFIELD, ILL.—Springfield & Northeastern Traction Company, Champaign. To be constructed from Springfield, Ill., to Bloomington, Ill. $1,500,000. Incorporators and first board of directors: Charley Zilly, W. H. Burke, Charles A. Wright, K. L. Doyle and George Mattis, all of Champaign, Ill.

LITTLE ROCK, ARK.—The Pan Long-Distance Telephone Company, Fort Smith. To build a long-distance telephone system over Arkansas and adjoining states and territories. $1,000,000. Charles Sutton, president; A. Arthur Latham, W. A. Latham, Edward Welleker, A. E. Boqua, Jr., and A. E. Boqua, directors.

AUSTIN, TEX.—Home Telephone Company, Weatherford, Parker county. To conduct a long-distance telephone business. $50,000. Incorporators: J. A. Murray and J. C. Caller, Fort Worth; R. S. Low, G. A. Holland, W. D. Carter, Charles C. Littleton, J. T. Cotton and E. P. Sawtelle, Weatherford, and R. Armstrong, Taylorville, Ill.

LYONS, N. Y.—Butler Independent Rural Telephone Company No. 1. To erect and maintain a telephone line between the villages of Wolcott and South Butler and vicinity. $1,000. Directors: Cyrus Aikens, of Savannah; John B. Aikens, Lucius H. Viele, L. I. Douglass, Delos S. Chapin, J. W. Miller, A. J. Ackerman, all of Butler.

SPRINGFIELD, ILL.—Illinois, Indiana & Gary Railway Company, Chicago. To be constructed from Peotone, Will county, Ill., to the Indiana state line at Beecher, Ill. $100,000. Incorporators and first board of directors: H. W. Saman, Clinton, Iowa; J. C. Duffin, Rockford, Ill.; B. H. Haris, F. M. Clark and W. F. McSwiney, Chicago, Ill.

SPRINGFIELD, ILL.—Illinois & Western Railway Company, Chicago. To be constructed from East Dubuque, Ill., across the Mississippi river to Dubuque, Iowa, and from East Dubuque, Ill., north to the Wisconsin state line. $5,000. Incorporators and first board of directors: Conrad H. Peppenhausen, Joseph L. McNab, Edward T. Fix, Michael Gesas and William G. Hamilton, all of Chicago.

ELECTRICAL SECURITIES.

A steady and fairly large recovery in prices was the feature of the past week's stock market. While this recovery was irregular, each session has been marked by some advances. The relaxation of the monetary situation is said to be the main cause of the recovery in prices and the improvement in speculative confidence. The signing of another three-year agreement by the anthracite operators and miners removes an important unfavorable influence from financial consideration. The same is true of the settlement of the strike on the Great Lakes. An important development of the week was the government May report on the crops, the prospects of which continue the promise of last month, and while somewhat less favorable, the winter wheat yield will be above the average. General trade and business show no indications of slackening. Railroad officials report a moderate decrease in tonnage, but reports of earnings are nearly all good.

ELECTRICAL SECURITIES FOR THE WEEK ENDING MAY 12.

New York:	*Closing.*
Allis-Chalmers common	21½
Allis-Chalmers preferred	57
Brooklyn Rapid Transit	83
Consolidated Gas	136¼
General Electric	167⅝
Interborough Rapid Transit	231
Kings County Electric	163
Mackay Companies (Postal Telegraph and Cables) common	70⅛
Mackay Companies (Postal Telegraph and Cables) preferred	73
Manhattan Elevated	152
Metropolitan Street Railway	113
New York & New Jersey Telephone	145
Western Union	92¾
Westinghouse Manufacturing Company	158

The Manhattan Railway Company's general balance sheet as of March 31, 1906, shows total assets of $106,285,842, and liabilities of $99,170,828, leaving a surplus of $7,115,014.

At the annual meeting of the General Electric Company, held May 8, the directors were reelected. The number of shares represented was 351,007.

The voting trustees of the Interborough Rapid Transit Company have reelected for the ensuing year the retiring directors. The first quarterly statement of the earnings of the Interborough since the merger of that system with the Metropolitan has been made public. The statement is for the quarter ending March 31, and shows gross earnings of $5,318,728 for both the elevated and subway. This is a gain of $736,006 over the corresponding period of 1905, which included the strike. Net earnings were $3,147,332, an increase of $623,927, and the surplus $1,109,138, an increase of $380,041. The sum of $649,731 cash on hand is reported, and a total profit and loss surplus of $2,096,548.

Boston:	*Closing.*
American Telephone and Telegraph	136½
Edison Electric Illuminating	246
Massachusetts Electric	66
New England Telephone	137
Western Telephone and Telegraph preferred	89

Philadelphia:	*Closing.*
Electric Company of America	11⅜
Electric Storage Battery common	71
Electric Storage Battery preferred	71
Philadelphia Electric	8 1/16
Philadelphia Rapid Transit	26½
United Gas Improvement (ex rights)	83

At the annual meeting of the stockholders of the United Gas Improvement Company it was decided to increase the capital stock from 734,500 shares of the par value of $50 to 918,005 shares of par value of $50 each. It is recommended that new stock be sold at its par value of $50 per share to the shareholders in the proportion of 25 per cent of their holdings of record at the close of business May 12. The right to subscribe will be evidenced by negotiable allotment certificates exchangeable for subscription certificates any time prior to June 15. Subscriptions will be payable in four installments. The net profits of the United Gas Improvement Company for the fiscal year ended December 31 were $5,070,165, an increase of $599,321. Net profits equal 13.8 per cent earned on nearly $36,750,000 stock outstanding and compare favorably with the net earnings of the previous year, being an increase of $599,325 over 1904, and marking the highest record figure in the history of the company.

Chicago:	*Closing.*
Chicago Telephone	120
Chicago Edison Light	145
Metropolitan Elevated preferred	68
National Carbon common	80
National Carbon preferred	120
Union Traction common	4½
Union Traction preferred	14

Directors of the Chicago Telephone Company will meet June 6, when it is reported the usual quarterly dividend will be declared. It is understood that no reduction in the payment will be made in the immediate future, possibly not for another year.

TELEPHONE AND TELEGRAPH.

AUSTIN, TEX.—The Postal Telegraph-Cable Company has established an office at Jacksonville.

GUTHRIE, OKLA.—A telephone company has been organized at Frederick and will run a line to Manitou.

CHANDLER, OKLA.—The Star Rural Telephone Company has its new line between Agra and Chandler *via* Parklands completed.

MONTGOMERY, ALA.—Fire recently destroyed the Western Union Telegraph Company's office on Commerce street, causing a loss of $50,000.

GLENS FALLS, N. Y.—The Western Union Telegraph Company is erecting a new line of poles between Fort Edward and Lake George along the Delaware & Hudson railroad tracks.

COLVILLE, WASH.—A new telephone line is being projected by the citizens of Echo Valley to connect that neighborhood with Colville, ten miles distant. The new line will be built at once.

MEXICO, MEXICO—A new telephone line is to be installed between the town of Chihuahua and the Santa Eulalia mining camp, with a central station in Santa Eulalia. Work is to commence at once.

BALTIMORE, MD.—The Chesapeake & Potomac Telephone Company is arranging to establish an exchange at Sparrows Point, to include not only the residents of the town, but others in the surrounding country and Patapsco Neck and Fort Howard.

AUBURN, N. Y.—The Cato & Meridian Telephone Company has elected the following directors to serve for one year: G. B. Hapeman, John E. Casey, Eugene Soule, James Mehan, L. D. Stafford, J. E. Turner, John K. Rich, G. V. Applegate and Smith D. Ward.

NEW HAVEN, CT.—The division headquarters of the Western Union Telegraph Company have been moved to New Haven. About 1,000 of the company's offices are in charge of the division, which includes Connecticut, Rhode Island and portions of New York and Massachusetts.

KIRKLAND, WASH.—The Kirkland Telephone Company's branch line to Redmond has been completed. This connects the five towns of Houghton, Kirkland, Juanita, Redmond and Bellevue and the farms between them. The company is composed of local people. A cable from Bellevue connects with the Independent Telephone system in Seattle, thus giving a long-distance as well as a local service.

HOPKINSVILLE, KY.—The independent long-distance telephone line from Hopkinsville to Henderson is now being completed. The Ideal Construction Company has for several months been putting up the poles and this part of the work has been completed. The line will be the property of the Central Home Telephone Company, which recently acquired all of the independent telephone lines in Kentucky and adjoining states.

WATERVILLE, ME.—The Western Union Telegraph Company has completed the laying of a seven-wire cable across the Kennebec between Bath and Woolwich. The distance across the river opposite Bath is 2,800 feet and the cable weighs 10,000 pounds. This is the first telegraph cable across the Kennebec at this point, although the New England Telephone Company already has one in place. The Western Union company's present cable crosses the river at Gardiner and the new one will shorten the route to Rockland about sixty miles. A new wire is also to be installed between Rockland and Wiscasset.

MASON CITY, IOWA—Improvements aggregating $200,000 have been planned for the Western Electric Telephone Company, whose headquarters are in Mason City. All the present lines will be rebuilt with new copper and iron wire, and new switchboards will be installed, which will accommodate an increase in the service. Several new lines will be built as follows: between Burt and Fenton; Spirit Lake to Jackson, Minn.; Rock Rapids and Estherville; Albert Lea *via* Mills and Forest City to Britt. New tolls have been established on all lines in Cerro Gordo county from the sixteen points who have direct connections with Mason City, a reduction of from ten cents to fifteen cents on each toll. A new equipment will also be installed in the head office at Mason City.

ELECTRIC LIGHTING.

ST. PAUL, MINN.—Staples is considering the matter of installing an electric light plant.

GREENVILLE, COL.—Lewisburg's council has passed a resolution to employ an engineer to make an estimate for a waterworks and electric light plant.

WACO, TEX.—The county commissioners have decided to place an electric light plant in the court house, the jail and other buildings belonging to the county. The contract has been let.

MANGUM, OKLA.—The electric light plant which was established three years ago in Mangum by E. W. Poth has been sold by him to the Galbraith-Fox Trading Company. The plant is valued at $12,000.

HARRINGTON, DEL.—A new and modern electric lighting system will be put into operation about July 1. Peale & Klehm have secured the franchise to light the streets and have begun building a power-house.

FAIRBURY, ILL.—The Fairbury Electric Light, Heat and Power Company has announced the consolidation of the plant in Chatsworth with the plant in Fairbury. It also announces a reduction in the price of lights.

STANBERRY, MO.—George S. Marshall, of Sedalia, has taken charge of the General Public Service Company's plant at Stanberry. The plant has been purchased by the company from T. D. Hussey and A. C. Frisbie for the sum of $25,000

PROVIDENCE, R. I.—W. L. Mauran, H. R. Rust and P. T. Curran, all of Providence, have incorporated the Westerly Power Company. The company is capitalized at $700,000, and is organized for the purpose of engaging in the sale of electricity and gas.

PITTSFIELD, MASS.—On account of the extensive improvements just undertaken, the Pittsfield Electric Company is to increase its capital stock, which at present is $150,000. The directors, at a meeting to be held shortly, will consider the advisability of adding $75,000 more, making a total of $225,000.

WINSTON-SALEM, N. C.—The plant, good will, etc., of the Winston-Salem Gas and Lighting Company have been sold by order of the Superior Court for $62,300. The successful bidders were William and Sinclair Mainland, of Oshkosh, Wis., who own and operate nine other plants. These parties owned bonds to the amount of $24,000.

ELK RAPIDS, MICH.—The council of Elk Rapids has granted a franchise for an electric lighting plant to A. B. Dougherty. The franchise calls for an all-night service, with a price of $75 per arc light for the first twenty-five lights; above twenty-five lights, $70. Six months are allowed in which to put the plant in operation. Elk Rapids is a town of about two thousand, and up to the present has been without any system of street lighting.

LYNCHBURG, VA.—At the May session of the Lynchburg city council the committee on lights will make a report in which the establishment of a municipal electric light plant in the pumping station of the waterworks will be recommended. The plant, it is estimated, will cost $50,000. The pumping station will be available for this purpose after the installation of the $500,000 gravity water system, which will be ready for use next fall.

WASHINGTON, PA.—The ordinance providing for the letting of the contract for lighting the borough for a period of five years has been signed by the burgess. The old contract with the Washington Electric Light and Power Company has expired, and by the signing of the ordinance the action of the council authorizing the contract to be relet to this company for a period of five years is approved. The contract price is $70 per year for each arc light, of which there are 184. Under the old contract the price per light was $83.

NORTH YAKIMA, WASH.—Preliminary to the plan of the present city administration for the building of a municipal water and light plant, Mayor Reed has filed two water appropriations in the county auditor's office. One is for 1,000 cubic feet per second to be diverted from the Naches river, a half mile above Horseshoe Bend, to be used for power purposes. The other is for fifty cubic feet of water per second from the same stream to be diverted a half mile above the mouth of the Tieton river, to be used for domestic and irrigation purposes for North Yakima.

ELECTRIC RAILWAYS.

SKANEATELES, N. Y.—The Auburn & Syracuse Electric Railway Company has been granted a franchise by the Skaneateles village board of trustees.

NORFOLK, VA.—The extension of the lines of the Norfolk, Portsmouth & Newport News Company to Churchland has been completed from Portsmouth to Churchland.

ALDAN, PA.—The Aldan borough council has given to the Philadelphia & Garrettford Street Railway Company the right to operate its line through the borough. This affords the corporation another stretch of territory in its effort to reach Chester.

WHEELING, W. VA.—William Lipphardt, of Martins Ferry, has been elected president of the Southeastern Ohio Railway, Light and Power Company; S. C. Hoffman, of Martins Ferry, has been elected vice-president. This company is constructing an electric road from Zanesville to Roseville.

BOYDS, MD.—Henry Phillips, of Washington, is said to have bought a controlling interest in the Kensington Electric Railway line that runs from Kensington to Chevy Chase. He proposes to run this line on to Sandy Springs across the country, about eight or ten miles from Kensington.

BLOOMSBURG, PA.—The board of directors of the Berwick & Nescopeck and Berwick & Suburban trolley lines held a meeting in Berwick recently, when the capital stock was increased from $1,000,000 to $1,500,000. The contracts for the power-house were approved, and work will be started within sixty days.

LYNCHBURG, VA.—The Norfolk & Western Railway has let the contracts for the construction of a double-track belt line around the city. The line will be twenty-two miles long, and seven firms will do the work. The company will urge that the work be completed as speedily as possible in order to obviate the congestion in the local yards. The improvement will cost upward of $2,000,000.

DES MOINES, IOWA—The board of trustees of the Iowa State Agricultural College has granted a right of way to the Newton & Northwestern Railroad for its interurban line. The line comes from Fort Dodge to Des Moines. The road purchased the motor car line to the college, which has been in operation for some time, and will use a portion of this for its interurban right of way.

CHATTANOOGA, TENN.—The Lookout Mountain Railway Company, in which stockholders of the Chattanooga Railway Company are interested, has applied for a charter, with $100,000 capital stock for the purpose of rebuilding the street railway on famous Lookout mountain. The incorporators are: Foster V. Brown, Frank Spurlock, R. W. King, D. J. Duncan and Thomas G. Newman.

WILMINGTON, DEL.—At the annual meeting of the Consolidated Railways, Light and Power Company all the old directors were reelected as follows: Hugh MacRae, M. F. H. Gouverneur, W. W. Randolph, George R. French, M. J. Heyer, C. W. Worth, B. G. Worth, G. Herbert Smith, James H. Chadbourn, Junius Davis, J. V. Grainger, Eduard Ahrens, Jurgen Haar, J. G. L. Gieschen and Oscar Pearsall, of Wilmington.

IRWIN, PA.—Pittsburg, Irwin & Greensburg men have applied for a charter for the Pittsburg, McKeesport & Westmoreland Railways Company. The line will begin at Herminie and will run over the West Newton road through Cowensburg and Blackburn to the Youghiogheny river at Gratztown. This road is intended as a connection with the line from Irwin to McKeesport, and the Manor Valley road from Manor to Irwin and Herminie.

APPLETON, WIS.—Upwards of $30,000 changed hands recently at Appleton when the management of the proposed Madison, Green Bay, Oshkosh & Southwestern Railway purchased all the land on which it has had option during the last four months. Practically all the right of way from Appleton north as far as Crandon has now been purchased, and work of laying rails has already been begun on the northern end of the line.

GREAT FALLS, MONT.—All of the property, including franchises, of the Great Falls Street Railway Company and the Boston & Great Falls Electric Light and Power Company has been transferred to the new company, which was recently incorporated in New Jersey under the name of the Great Falls Electric Properties, with a capital stock of $1,000,000, the incorporators being Pressly E. Bisland, of Bronxville, N. Y.; W. S. Brayton, of East Orange, N. J., and Robert Randall, of New York.

YELLVILLE, ARK.—The city council of Yellville has granted C. L. Morgan, of Detroit, a franchise to build an electric railroad through the town. Mr. Morgan secured the franchise in the interest of Detroit capitalists, who are heavy property owners in Marion county, and have lately taken a number of zinc mining leases in the Rush and Jimmy creek districts. The plant is to build from Yellville south into the Rush creek country and north into the Jimmy creek district, connecting with the White River line at or near the depot.

VINCENNES, IND.—In order to permit of the immediate beginning of construction work on the Vincennes, West Baden & Louisville traction line, the directors reorganized by electing the following officers: president, T. H. Adams, of Vincennes; vice-president, Lewis Metesser, of New Orleans; secretary, Anthony M. Yelton, of Vincennes. Mr. Metesser, representing an eastern construction company and also the Philadelphia capitalists who financed the road, with G. W. H. Roush, a local director, will superintend the construction, which is to begin at once. The company expects to have cars in operation by November. The road will be first built to Petersburg, thence to West Baden and Louisville.

COLUMBUS, OHIO—The plans of the Schoepf syndicate for the consolidation and formation of the largest electric system in the country are rapidly developing, and before the close of the present summer the Indiana, Columbus & Eastern Traction Company will have through limited cars in operation between Zanesville, Columbus and Indianapolis; Zanesville, Columbus and Cincinnati, and from Cincinnati to Indianapolis. To accomplish this, many improvements are being considered in the way of additional motive power, betterment of roadbed and improved terminal facilities. To increase the power of the lines, substations are to be located at various points. One of these will be placed near Alum creek on the Columbus, Newark & Zanesville road.

FAIRFIELD, IOWA—The project of an interurban railway between Fairfield and Keosauqua has been revived, and it is believed that it will be carried out. It is proposed to use the Des Moines river to furnish power, not only for railway purposes, but also for lighting and power in the towns along the right of way. The project is being investigated by four Indiana men—Henry Buser, Frank Draggoo, A. W. Carpenter and J. T. Carpenter—whose plan is to organize a company with a capital of $1,000,000, of which amount $150,000 is to be in preferred stock, with a guaranteed dividend of six per cent, and to have a tax voted by the towns and townships through which the proposed road will pass. If this is successfully accomplished it is proposed to bond the road for $500,000, and with the money already on hand to build and equip it.

WASHINGTON, D. C.—The United States Circuit Court of Appeals at Richmond, Va., having denied the mandamus sought by F. D. Zell and associates to hold up the sale of the Bay Shore Railroad, the property was put up at auction at Norfolk and sold to Edward B. Smith, of Philadelphia, for $765,000, on which $50,000 was paid in cash. The remainder of the purchase price is to be paid in cash and bonds held by Edward B. Smith & Company within thirty days. The receivers are to continue the operation of the road until the sale shall have been confirmed by the court. The sale of the Bay Shore to Smith means that it has been acquired by the Norfolk & Portsmouth Traction Company, which recently took over all the traction and lighting properties in that section, with the exception of the Bay Shore and the Norfolk & Atlantic Terminal properties, under a $14,000,000 merger.

WASHINGTON, PA.—The Pittsburg Railways Company has begun preliminary work in the construction of a new trolley line from Castle Shannon to Canonsburg. The contract for the building of the road has not been let and the present work is being done by the company itself. The initial work consists of the filling of the right of way just east of Canonsburg. A large force of men has been secured, and the work is to be rushed. The Pittsburg Railways Company has accepted the franchise granted by the Canonsburg council across East College street. One specification in the franchise is that cars be running between Pittsburg and Canonsburg by November 1 of this year. The Pittsburg Railways Company officials claim that the road will be completed by that time, and that cars will be operated regularly between Washington and Pittsburg.

INDUSTRIAL ITEMS.

THE PITTSBURGH TRANSFORMER COMPANY, Pittsburgh, Pa., is distributing its characteristic calendar card.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, announces the removal of its New York office to 1123 Broadway.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., in bulletin No. 31 describes attachment plugs, panel boxes and new taplets.

THE ELECTRIC CABLE COMPANY, New York city, in order to secure adequate quarters for handling its increasing business, moved on May 1 to 17 Battery place.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., has ready for distribution a new series of bulletins to take their places in its perpetual catalogue.

THE J. LANG ELECTRIC COMPANY, 116-128 North Lincoln street, Chicago, Ill., has published an attractive booklet describing the McWilliams universal metering panelboard.

THE LYON METALLIC MANUFACTURING COMPANY, Chicago, Ill., will be pleased to send its new catalogue descriptive of the Lyon steel trucks for factories, foundries, shops, etc., to any one interested upon request.

THE CLARK INSULATION COMPANY, Boston, Mass., announces that the name of the company has been changed to the Boston Insulated Wire and Cable Company. The ownership and management remain the same.

DODGE & DAY, Philadelphia, Pa., have been commissioned by the Kerr-Murray Manufacturing Company, Fort Wayne, Ind., to erect and equip a new plant. Preliminary work is about completed, and construction will be started at once.

THE COOPER HEWITT ELECTRIC COMPANY, 220 West Twenty-ninth street, New York city, in bulletins No. 10 and No. 11 describes and illustrates, respectively, Cooper Hewitt mercury vapor lamps for direct current and for alternating current.

THE ROBINS CONVEYING BELT COMPANY, New York city, has issued bulletin No. 14 describing and illustrating Robins' belt conveyors for handling excavated earth and rock and concrete materials. Many remarkable applications are shown, and the text is instructive and interesting.

THE NATIONAL CARBON COMPANY, Cleveland, Ohio, is distributing a very attractive folder bearing the impression of a bull's-eye. This calls attention to the aim of the company, which, it is stated, has been, and always will be, to maintain the high standard of quality of "Columbia" carbons.

THE STANDARD ELECTRICAL MANUFACTURING COMPANY, Niles, Ohio, is distributing a folder calling attention to the advantages of the "Star" incandescent lamp. This folder also contains the official National League, American League, American Association and Eastern League baseball schedules for 1906.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., announces that its sales office formerly located in San Francisco, Cal., has been transferred to 525 Thirteenth street, Oakland, Cal. All business connected with the Pacific coast territory will be handled from this office.

THE ABNER DOBLE COMPANY, 2611 Broadway, San Francisco, Cal., announces the loss in the recent fire of some of its correspondence and drawings. In order to check up its files and make its records complete the company is requesting its patrons to send copies of drawings and blueprints and of recent correspondence.

THE HOLTZER-CABOT ELECTRIC COMPANY, Brookline, Mass., announces that it has severed its connection with W. Green & Company, 6 Maiden lane, New York city. This company has been handling the Holtzer-Cabot Company's motors in the jewelry and optical trades. The company will hereafter sell its motors to the jewelry people direct.

FAIRBANKS, MORSE & COMPANY, Chicago, Ill., announce temporary headquarters at 969 Broadway, Oakland, Cal. The company expects to be able to return to its permanent location in San Francisco in due time. It has sold recently a large number of its standard mine cars to the Republic Iron and Steel Company, the Nassau Ore Company, the La Rue Mining Company and the Rhodes Mining Company.

THE DE VEAU TELEPHONE MANUFACTURING COMPANY, New York city, has recently issued some literature on telephone apparatus especially descriptive of its intercommunicating system. This De Veau literature is especially bright and unique in preparation. One of these little bulletins is of interest to the historian, inasmuch as it has a description of some localities of interest because of colonial war associations.

THE AITON MACHINE COMPANY, New York city, has found it necessary to install a number of new machine tools in its factory at Harrison, N. J. The company has been experiencing a continued expansion of business, and has made improvements in every department. The new tools are all especially adapted to the Aiton Machine Company's work, which is the manufacture of wire, cabling, stranding and rubber machinery.

THE STANDARD VARNISH WORKS, 29 Broadway, New York city, is publishing a little booklet designated as "The Insulator." This will contain special articles concerning applications of insulating varnish. Several brief sketches are entitled as follows: "How Varnish Cuts the Cost of Expenses"; "A New Kind of Electrical Varnish," and "How to Buy Electrical Varnish." This book will be sent to any one interested upon request.

THE CONSOLIDATED ENGINE-STOP COMPANY, 130-133 East Twelfth street, New York city, has published a new catalogue entitled "The Protection of a Monarch." This catalogue describes the application of the "Monarch" system, and gives some views of installations where this system has been adopted. In addition to this there are a number of testimonials from companies who have found the system of advantage in case of accident.

THE CONNECTICUT TELEPHONE AND ELECTRIC COMPANY, Meriden, Ct., has placed the Pacific coast agency for its spark coils with the George P. Moore Company, Incorporated, Oakland and Los Angeles, Cal. The Moore company's establishment at San Francisco was destroyed by the recent fire, but the company promptly opened a branch at Oakland, where a large stock is being carried. About a year and a half ago the Connecticut company commenced a series of experiments for the purpose of improving the electric sparking equipment of gasolene engines. The new coil is of very high quality and represents twelve years' experience in the manufacture of high-grade electrical apparatus.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., reports a very busy condition in its electric locomotive construction department. Within the last week or two orders have been received for no less than fifty electric locomotives. Some of these are for mining plants and will be used in hauling coal in the pit. Others are for manufacturing plants, where the electric locomotive is now finding extensive use in the transportation of material from the shops to the railroad siding. Owing to the facilities of the Westinghouse shops for the construction of electric railway material, and because of the existing arrangement between the Westinghouse company and the Baldwin Locomotive Works, the Westinghouse company is securing a very large portion of this class of electrical business.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., is distributing a new series of timely advertising literature. Price list 5145 deals with type H oil transformers. Price list 5146, type HB oil transformers. Price list 5147, electric heating devices. Supply catalogue 7596, Sprague-General Electric type M-control apparatus. Supply catalogue 7597, marine supplies. Flyer 2175, type SC no-voltage and overload release for use with shunt or compound-wound motors; 2178, key and keyless receptacles; 2179, all porcelain wireless clusters; 2180, porcelain sockets; 2181, receptacles for outdoor wiring; 2182, type MA13A copper ribbon fuse box; 2183, type MS8 hood switch for railway service; 2184, type, I, form D and form D-2 fuse holders. A new catalogue descriptive of lightning arresters is very complete, instructive and interesting.